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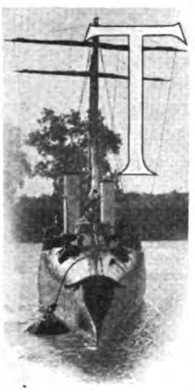
The Evolution of Speed in Torpedo Boat Destroyers

By Fred A. Talbot



SPANISH DESTROYER ARIELE

THE development of torpedo boat destroyers has been made a special study by Sir John I. Thornycroft, and in this particular line has achieved conspicuous success, since he has succeeded in producing torpedo boats which as representatives of their respective periods proved the fleetest afloat. He it was who built the first torpedo boat for the British navy in 1876. This was the "Lightning," known in the service as "No. 1," and it proved to be the percursor of a long series of vessels remarkable for the speeds they attained. The "Lightning," as may be seen from the accompanying illustration, is practically no larger than the modern steam launch, and incidentally, in comparison with the later vessels of this type, it affords an interesting and striking study of the remarkable developments that have been effected in the design of this class of mosquito craft during the past 30 years. It measured 84 ft. 6 in. in length, with a beam of 10 ft. 10 in., and drew 5 ft. of water. The engines were of the compound surface condensing pattern with cylinders of 12¾ in. and 21-in. bore respectively by a common stroke of 12 in., and developing 460 indicated horsepower. Its armament comprised only a spar torpedo gear fitted in the bow. Its speed was 18 knots (20.75 miles) per hour.

The speed successes of the "Lightning," despite its being a pioneer war vessel designed for a special phase of operations, aroused the interest of naval engineers throughout the world, since it was realized that such small vessels of light weight combined with high speed would be of invaluable service in overhauling surreptitiously the largest and slower war-clads, discharge their torpedo, and be able to get away without detection. The result was that the torpedo boat became established as a fighting unit. But this development resulted in the demand for a similarly light vessel which should be of greater speed so as to be able to overhaul the torpedo boat and thus nullify its intentions, and the torpedo boat destroyer was consequently evolved. In this latter development Sir John

TORPEDO BOAT DESTROYER LIGHTNING (1876), THE FIRST TORPEDO BOAT BUILT FOR THE BRITISH NAVY.

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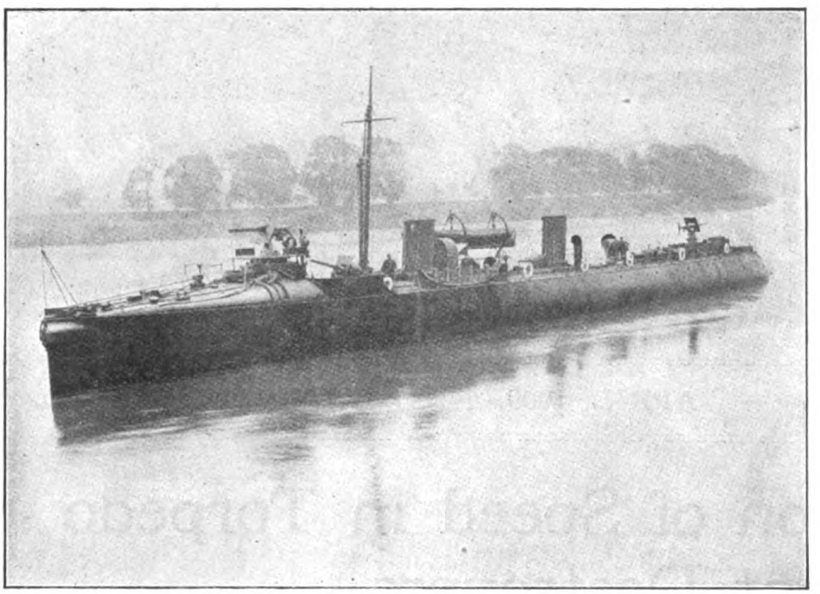


H. M. S. DARING, THE FIRST BOAT TO ATTAIN A SPEED OF 28 KNOTS.

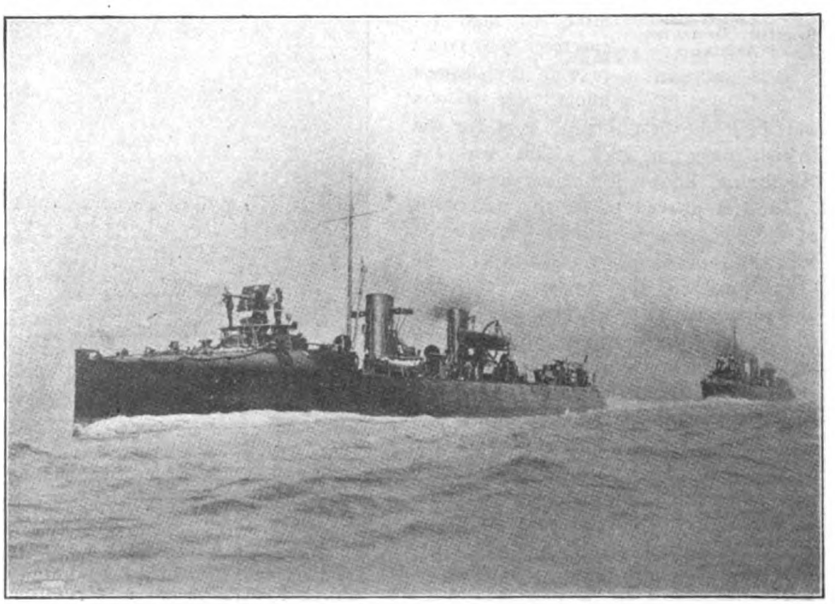
Thornycroft played a conspicuous part, for in 1886 there was built at Chiswick the first vessel to attain a speed of over 27 knots (31.125 miles) per hour. This was the destroyer "Ariete," which went through the Spanish-American war, and which vessel is still in service. It was a two-funneled boat, 148 ft. 3 in. in length by 14 ft. 6 in. beam, and a draught of 5 ft., and was conspicuous for the rounded forward deck which has since proved a feature of vessels of this class.

During the next few years efforts were made to secure still greater speed, which attempts were assisted by the invention of forced draft, which was evolved by Sir John Thornycroft, and in 1894, Messrs. Yarrow & Co. produced a new torpedo boat destroyer for the British navy which attained a speed of 28 knots (32.278 miles) per hour. A few days later the "Daring," which was the first of five similar boats which were under construction at Chiswick for the British navy, eclipsed this achievement by notching an extra knot, the speed on the measured mile against the tide being 29.268 knots (34.72 miles) per hour. The "Daring" was 185 ft. in length, with a beam of 19 ft., and a draught of 7 ft., the displacement being 260 tons.

This craft was notable for many improvements. In the first place, the Thornycroft water-tube boiler was employed for raising steam, there being a battery of three installed and capable of raising steam to 210 lbs. per sq. in. pressure from cold water within the space of 15 minutes. The engines too were balanced upon a system that the builders, as a result of their investigation and experiment, had found to minimize vibration, the eight cylinders arranged in pairs driving cranks set at 180 deg., so that the inertia stresses were self contained. The engines were of the triple expansion type, indicating from 4,700 to 44,800 horsepower, driving twin screws, and the beneficial effects of the balancing system adopted were strikingly emphasized when traveling at full speed, there being but little vibration perceptible. Another innovation which proved highly successful was the incorporation of double rudders whereby the maneuvering capacity of the boat at the highest speeds was considerably increased, together with the patent apparatus for rapid steering when running astern.

Another very noticeable improvement was the absence of any bow or stern wave owing to the fine lines of the vessel's hull. The wake showed the spinning effect of the propellers very clearly without any upheaval, the wake being as flat at the maximum as at half speed. This happy result was due to the Thornycroft design of stern, which has always constituted one of the most prominent features of this fast class of craft with which they have been identified. The stern is of full midship breadth immediately above the water-line, and forms a chamber drawing a few inches of water, thus completely immersing the propellers though at the same time enabling them to work near the water's surface without splashing or any loss of power through racing. The vessel had bunker capacity for 60 tons of coal which was sufficient for a radius of 3,000 miles at a cruising speed of 10 knots. Her armament comprised one 12-pounder, three 6-pounder guns, and two torpedo tubes.

In the years 1895 and 1896, further speed records were achieved by the "Boxer" and "Desperate" respectively. The success of the water-tube boilers



TORPEDO BOAT DESTROYER BOXER WITH BRUISER ASTERN, FIRST BOAT TO ATTAIN A SPEED OF OVER 29 KNOTS.

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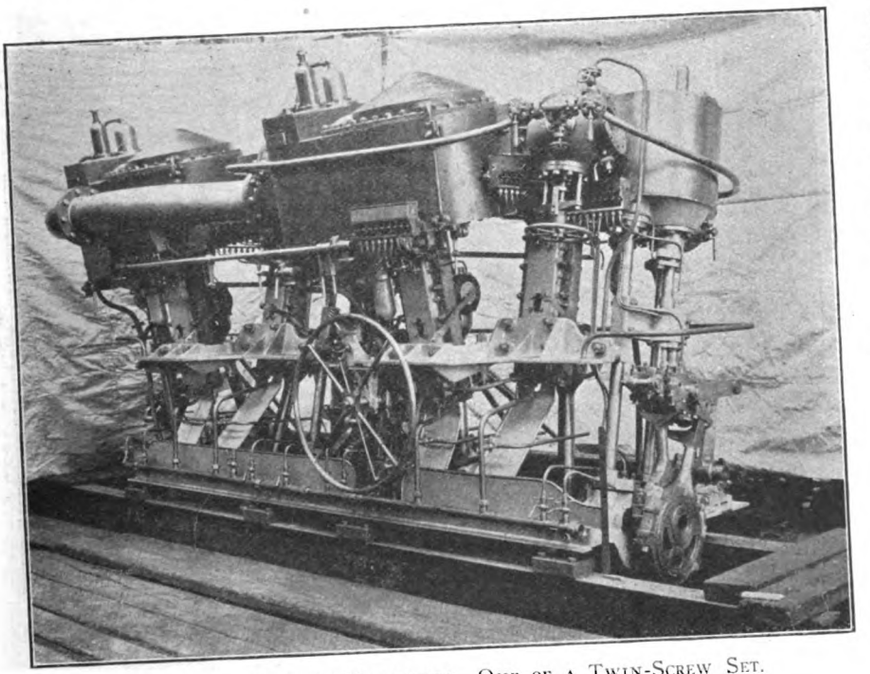
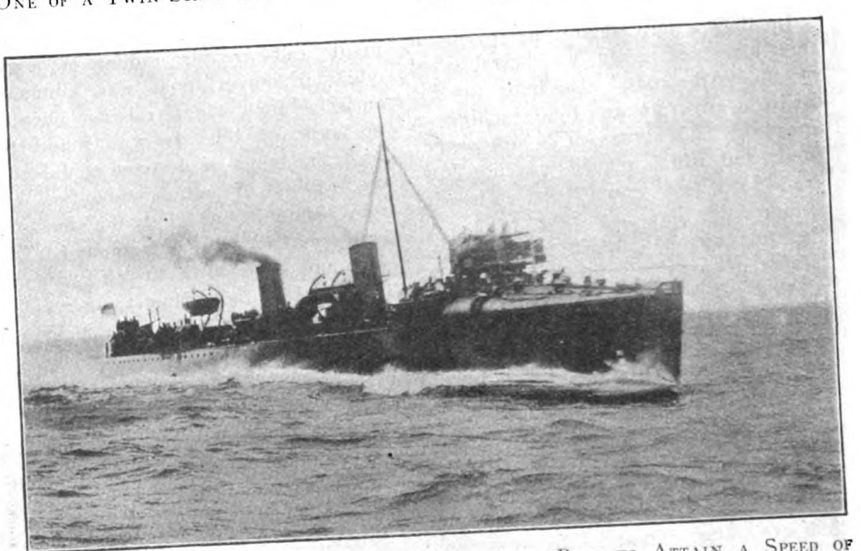


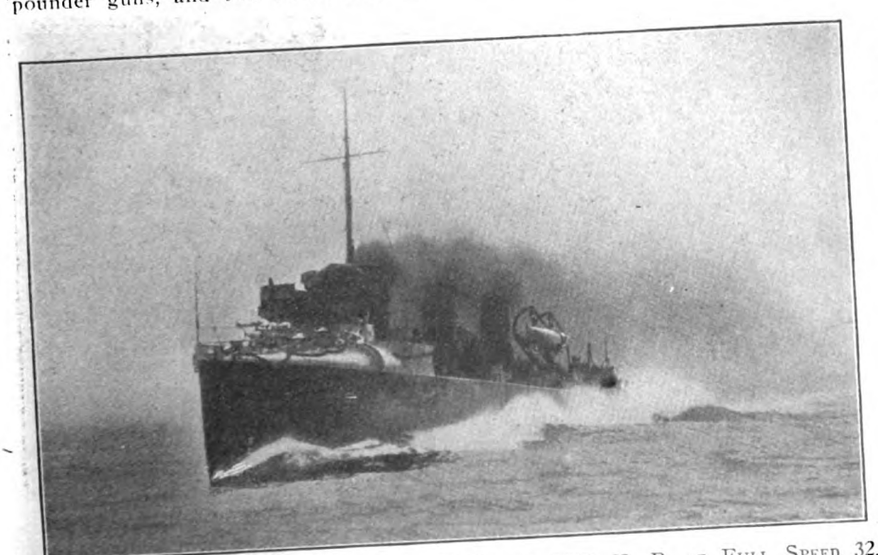
BOXER AND BRUISER MACHINERY—ONE OF A TWIN-SCREW SET.

for steam raising and the absence of vibration owing to the Thornycroft system of balancing the engines, together with the stern lines of the vessel's hull, which prevented the propellers racing in choppy water, as exemplified in the "Daring," resulted in these principles being adopted in the later vessels. Advantage, however, was taken to increase their dimensions. The "Boxer" was 200 ft. over all by 19 ft. beam, and with a draught of 7 ft. 1¼ in. The propelling machinery comprised four cylinder compound engines having cylinders of 19 in., 27 in. and two 27-in. bore respectively, with a common stroke of 16 in. developing 4,500 horsepower. The armament comprised one 12-pounder quick firer, five 6-pounder guns, and two 18-in. torpedo tubes. On her trials this boat reached a speed of 29.170 knots (34.45 miles) per hour.

The "Desperate," which formed one of a flotilla of six vessels of the destroyer class ordered from the Chiswick firm for the British navy, followed the design of the "Daring" very closely, the only important modifications being increased dimensions, increased power necessitating the installations of larger boilers and engines, the Admiralty stipulating for a speed of 30 knots, or three more than that contracted for in the case of the "Daring." While to secure this desired result more power was necessary, it was at the same time imperative that the weight of the vessel should not be increased and consequently a reduction in the weight was effected wherever possible. This end was achieved by the utilization of the new special steel that had been manufactured especially for this class of warship construction, having a tensile strength of 38 to 43 tons per sq. in. This enabled all scantlings to be reduced without in any way sacrificing strength. The "Desperate" had a length of 210 ft. with beam of 19 ft. 6 in. and a draught of 7 ft. 2 in., the displacement being 310 tons. The armament consisted of one 12-pounder and five 6-pounders, with two torpedo tubes.



TORPEDO BOAT DESTROYER DESPERATE (1896). FIRST BOAT TO ATTAIN A SPEED OF 30 KNOTS.



TORPEDO BOAT DESTROYER ALBATROSS (1899) OF 8,000 H. P. AT FULL SPEED 32.3 KNOTS.

One advantage arising from the lines of the Thornycroft hulls forward and which is greatly appreciated by the officers and crew, more especially when traveling at full speed, is the dryness of the decks. This is attributable to the design of stem adopted and which as a result of continued experiments has proved the most successful for preventing either

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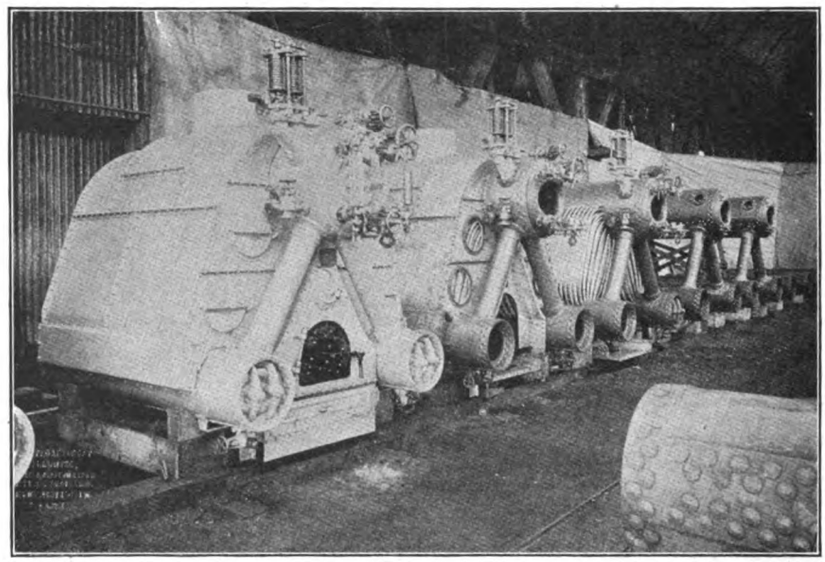
shipping of water or production of spray. In such craft, when running at high speed, the tendency of the stem is to throw up considerable spray at the point where it cuts the water. This in itself may seem somewhat insignificant, but when it is remembered that the drops of water cut the faces of the crew aft on the deck like hail, and in a breeze renders it amost impossible to stand against it, the seriousness and discomfort arising from such prevailing conditions may be realized. This is overcome by making the stem instead of raking aft from the water-line, to slope forward, the rake being as much as 2 ft. between the water-line and the extreme forward end of the deck. In the trials carried out by the Admiralty the "Desperate" attained 0.75 knot in excess of that required according to the contract, notching 30.75 knots (35.44 miles) per hour with an actual mean speed of 30.428 per hour.

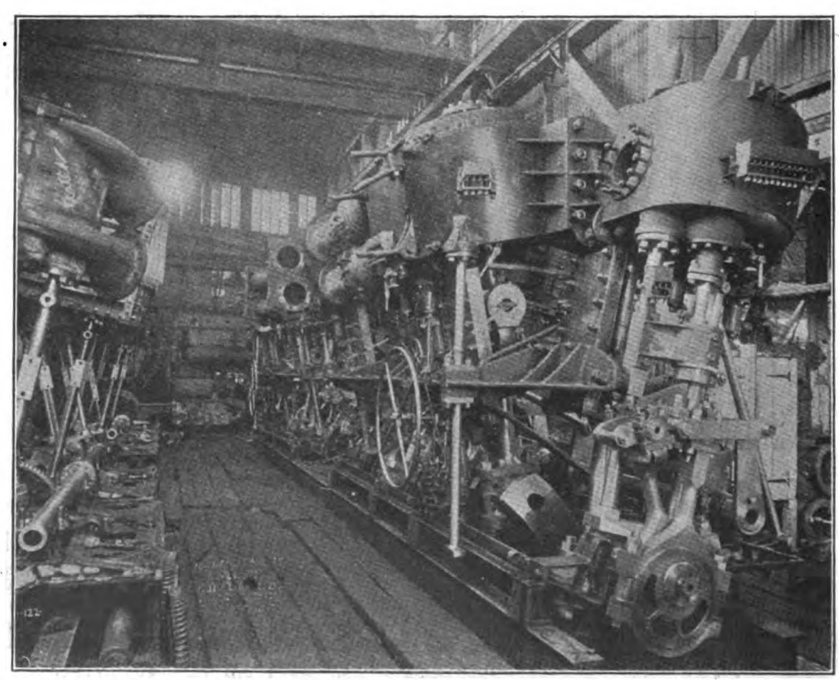
In 1899 a new record in speed for this class of craft was established by the "Albatross," also built for the British government, by reaching a speed of 32.3 knots (37.24 miles) per hour, and which record was not lowered until two years later. The developments that had taken place in the increase of the dimensions and power of previous successive vessels of this type was carried still further, the length of the boat being 227 ft. 6 in., with a beam of 21 ft. 3 in., and a draught of 8 ft. 6 in. The machinery consisted of the Thornycroft triple expansion compound surface condensing engines with cylinders of 22-in., 33½-in., and two 36-in. bore by 20-in. stroke, and developing 8,000 indicated horsepower, driving twin screws and with steam raised by a battery of Thornycroft water-tube coal-fired boilers.

With the remarkable record set up it was considered that practically the limit in speed in such vessels of this caliber had been attained with reciprocating engines. Within the past five years the Parsons turbine has established its capabilities very firmly and the experiments of the Admiralty having confirmed the utility of this type of prime mover to warship practice, when the orders for the construction of the last batch of torpedo boat destroyers were given out to the various shipbuilders of Great Britain, turbine machinery was stipulated. These vessels, of which the "Tartar" constitutes a unit, are of a new type of destroyer, officially known as the "ocean-going" class,



WATER-TUBE BOILERS OF THE ALBATROSS, THORNYCROFT TYPE.

the distinguishing feature being not only high speed, but greater constructional strength, heavier displacement and greater radius of action, while moreover, coal was eliminated entirely for steam raising purposes in favor of oil. It was found that with the types of destroyers described the radius of action was not only very limited, but that the limits of lightness had been overstepped. They were not sufficiently strong for service in any but the calmest of weather, there being a tendency in a sea-way for the boats to crumple up and break their backs, which contention was supported by the mysterious disappearance of one or two vessels of this description, such as the "Cobra," with all hands. Under these circumstances, it was decided to evolve a heavier class of destroyers, no matter if the speed had to be somewhat sacrificed, since it was conceded that the other advantages which would be secured would more than compensate for any reduction in pace. The perfection of the Parson's turbine combined with the high-speed tests that had been obtained in other classes of vessels engined therewith, removed any apprehensions regarding



MACHINERY OF THE TORPEDO BOAT DESTROYER ALBATROSS. FOUR CYLINDER, TRIPLE-EXPANSION 22, 33½, 36 AND 36 IN. BY 20 IN. STROKE.

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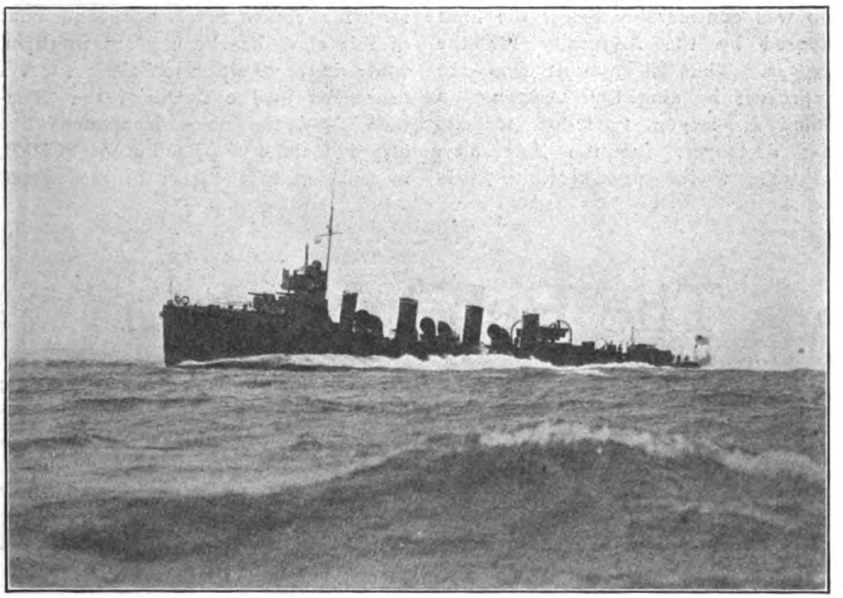


TORPEDO BOAT DESTROYER TARTAR MAKING 34.5 KNOTS.

speed losses and consequently when the last contract for destroyers was handed out a speed of 33 knots was stipulated.

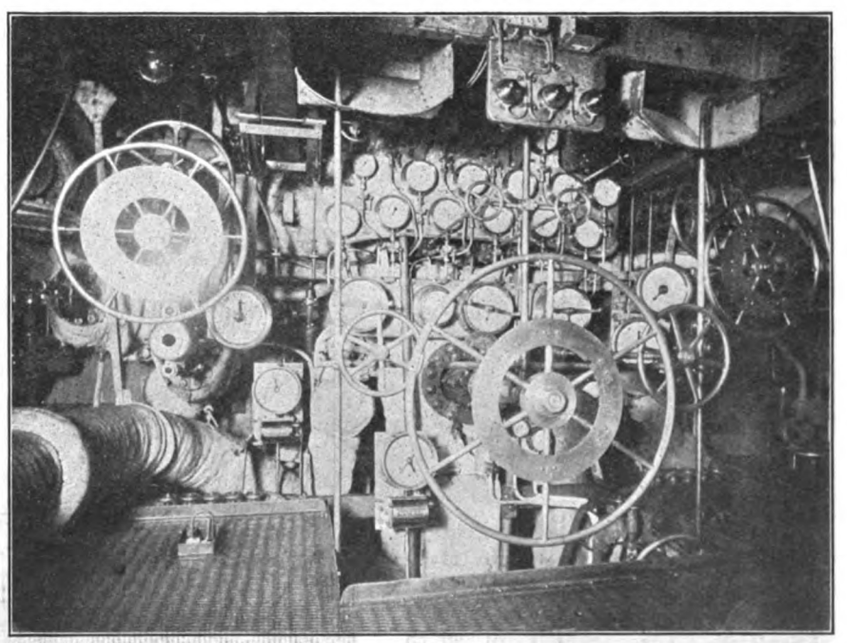
So far four of these vessels have been completed by various shipbuilders, and in each case the 33-knot (38 miles) per hour has been exceeded, but the most striking excess is that of the "Tartar." This boat is 270 ft. in length on the water line by 26-ft. beam, and has a depth of 17 ft. 2 in., with a displacement of 850 tons. The shape of the hull follows the general Thornycroft practice, including the graceful turtle deck in place of the clumsy raised forecastle, thus throwing water overboard instead of under the upper deck. High tensile steel is used almost throughout, while every care has been exercised to secure the maximum of strength in the hull with the minimum amount of material.

Steam is raised by a battery of six water-tube boilers of the Thornycroft type, oil-fed exclusively, the fuel used being heavy oil injected into the furnace by means of special burners of Admiralty pattern. This combination provides a steady and ample supply of steam, the working pressure being 220-lbs. per sq. in. The tubes are straight except at the ends where they enter the steam and water barrels, and the design lends itself well to the protection of the upper barrel from the fierce heat of the oil fuel furnace. Each boiler has 5,300 sq. ft. of tube surface; the firebox tubes are 1⅜ in. in diameter and 10 l. s. g. thick, and the remainder are 1⅛ in. in diameter and 12 l. s. g. thick.

Many advantages are derivative from the utilization of oil fuel, not the least being the freedom from smoke, as may be seen from the accompanying illustration of the "Tartar," which shows the vessel running at 34½ knots, there being scarcely a trace of smoke visible. This is attributable in a great measure to the precision with which the necessary amount of air can be adjusted for perfect combustion. Another important consideration is the freedom from the continual shower of ashes ejected from the funnels and falling upon the deck as prevails in coal burning vessels, together with the total absence of flaming at the funnels. Moreover, the ease with which the speed may be reduced almost instantly by the adjustment of the fuel feed is a very important consideration. The machinery comprises Parson's turbines.

The vessel will be fitted with wireless telegraph apparatus, while mechanical means are provided for ventilating the engine room when the hatches are closed down in bad weather. The usual installation of speaking tubes is superseded by a complete plant of loud speaking telephones which are fitted to all the important stations throughout the ship. The main deck is not obstructed by high combings along the boiler rooms—an advantage due to the Thornycroft type of boiler—thereby providing facilities for easy passage from side to side.

In the case of the official trials for the vessels of this class much more severe requirements were imposed by the Admiralty. Instead of making allowances in the way of load in the full speed trials, as was formerly the case, the vessels had to be in complete war trim with full complement of men, fuel, stores, etc., and armament, which in these vessels consists of three 12-pounder quick firing guns —the 6-pounders being dispensed with —and two torpedo tubes. Moreover, instead of being subjected to a one or



TURBINE ROOM OF THE TARTAR. STARTING PLATFORM SHOWING ARRANGEMENT OF STEAM VALVES AND PRESSURE GAGES.

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two hours' continuous run at full speed, in the case of the "Tartar" this was increased to 6 hours.

In the first official trials the speed actually attained as a mean of six runs on the measured mile was 34.857 knots (40.18 miles) per hour, although carrying a greater load than stipulated by the contract. During the two hours' continuous run the speed maintained was only a fraction less being 34.7 knots. The greatest achievement was, however, attained in the final speed trials. The boat traveled from Southampton, where she was built, to the mouth of the Thames, where the Admiralty measured mile is laid out, at 34 knots, this being in the open sea, and then reached an unprecedented speed of 37.037 knots (42.696 miles) per hour. A speed of 35.363 knots was maintained continuously throughout the six hours continuous high speed trial, during which time the vessel covered nearly 233 miles. The following table gives the comparative speeds that have been attained by the first four of these 33-knot turbine destroyers:

Vessel—	Speed on measured mile.	Speed throughout six hours' run.	Speed on best run over measured mile.
Cossack	33.15 knots	33.1 knots	33.65 knots
Ghurka	34.00 knots	33.91 knots	..... knots
Mohawk	34.51 knots	34.245 knots	35.294 knots
Tartar	35.678 knots	35.363 knots	37.037 knots

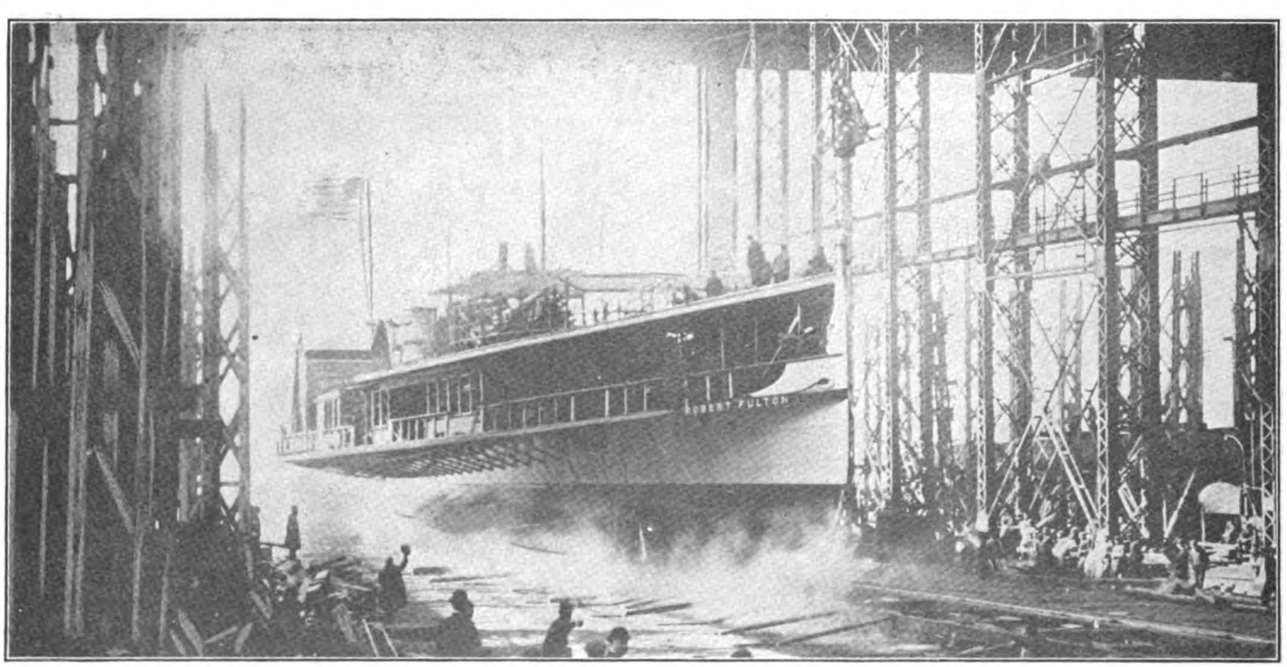
During the whole of the severe trials with the "Tartar" the machinery was observed to work smoothly, a full head of steam being easily maintained, while the fuel consumption was considerably below the limit imposed by the Admiralty for the purpose. The Thornycroft firm are at present building the "Amazon," a somewhat larger type of torpedo boat destroyer, for the Admiralty, but owing to the success of the "Tartar" the contract for a second boat of this class has been given to them, while in recognition of their success in regard to the speed of the "Tartar" itself, the navy department has awarded them a premium of $60,000, in addition to the cost of the vessel.

The Robert Fulton

THE side-wheel steamer Robert Fulton, the latest addition to the fleet of the Hudson River Day Line, was successfully launched at the yards of her builders, the New York Ship Building Co., on March 20. The initial appearance of this magnificent steamer in service on the Hudson will mark not only the commencement of the celebrations commemorating the 100th year of commercial steam navigation on the Hudson river and the 300th anniversary of the discovery of the river by Hendrick Hudson, but a record in expeditious ship building. The work of construction commenced on Jan. 11, and in less than 10 weeks from that date the Robert Fulton floated with propelling machinery installed and part of her upper structure completed.

The general dimensions of the new steamer are: Length over all, 348 ft.; beam over all, 76 ft., and depth of hold 12 ft. 9 in. Her propelling machinery was built at the yards of the W. & A. Fletcher Co., Hoboken, and consists of a beam engine with cylinder of 75 in. diameter by 12 ft. stroke; indicating 3,850 H. P. and driving the vessel at a speed of over 24 miles per hour. The paddle wheels are of feathering type.

The entire construction, so far as is practicable, is of steel, glass, asbestolith, composite board and metal trim, making the vessel as nearly fireproof as is possible. Her carrying capacity will be 4,000 passengers and her accommodations throughout especially elaborate. The main saloon, dining room, and parlors have mural decorations comprising historic sketches and portraits. A large open lunch room, near the orchestra, will be treated in ship cabin style. The



LAUNCHING THE ROBERT FULTON AT THE YARD OF THE NEW YORK SHIP BUILDING CO., CAMDEN, N. J.

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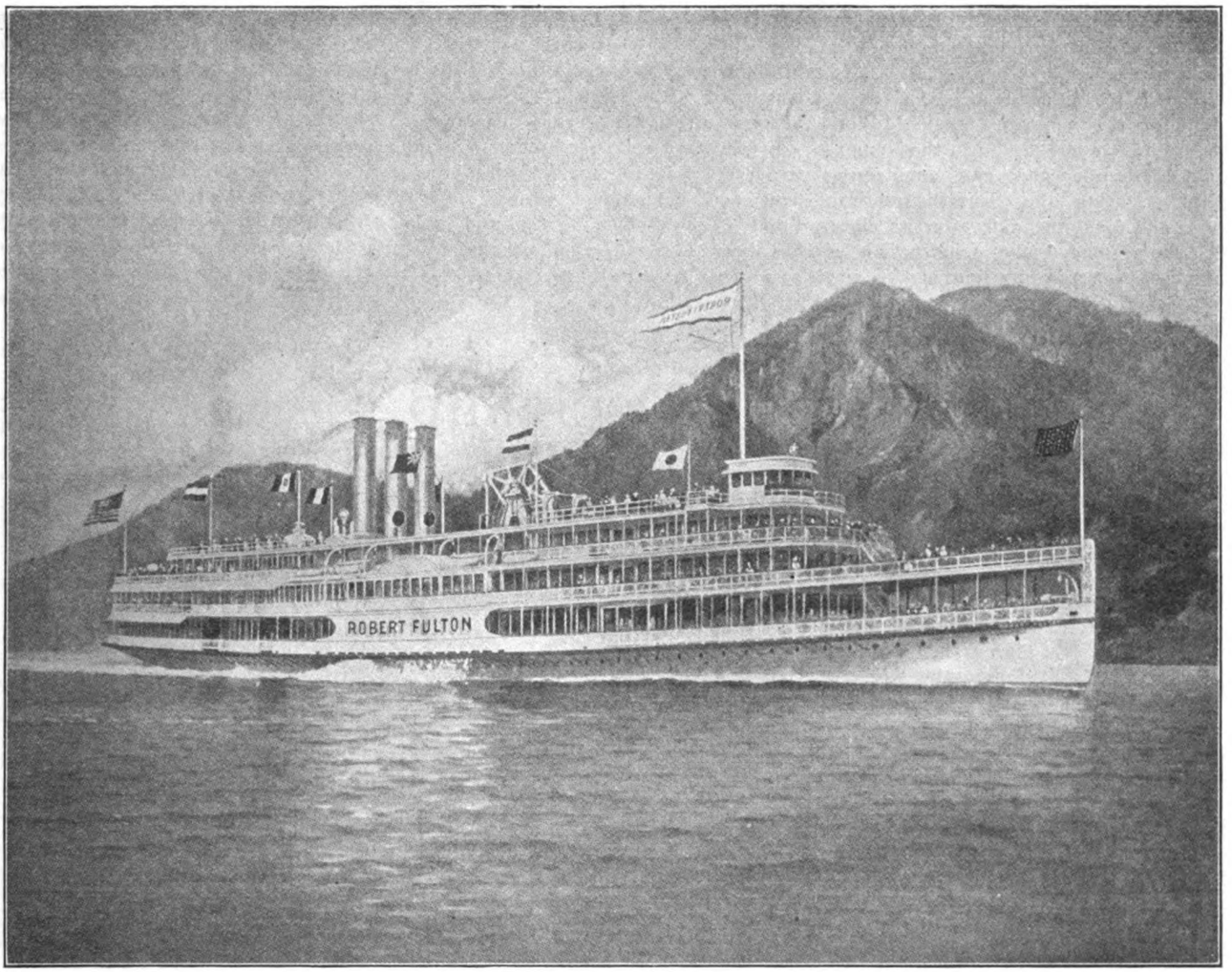

THE HUDSON RIVER DAY LINE STEAMER ROBERT FULTON AS SHE WILL LOOK WHEN COMPLETED.

dining room, situated on the main deck aft, will be in Delft. The Robert Fulton will have four decks, namely: Main, saloon, grand promenade, and observation decks.

Owing to the fact that the vessel was built entirely under cover, making day and night work possible in all kinds of weather, the New York Ship Building Co., were enabled to turn her out in record-breaking time. The fitting out is now proceeding rapidly, the Robert Fulton being scheduled to go into commission on May 29. This means that only four and one-half months will elapse from the laying of the keel until the vessel is completed. Frank E. Kirby and J. W. Millard, naval architects and consulting engineers, are the designers of the Robert Fulton. Miss Anita Merle Smith, daughter of the Rev. and Mrs. Wilton Merle Smith, and grand-daughter of Commodore Alfred Van Santwood, founder of the Day Line, christened the vessel.

The Robert Fulton will be the second steamer of her type to be placed in the Hudson River Day Line service by this company within recent years, the Hendrick Hudson being too well known and much appreciated on this route to need further mention here. Along the entire route of its steamers the Day Line has done much to beautify the Hudson and add to the pleasure and comfort of the patrons of the company. In addition to the magnificent pier at West Forty-Second street, New York City, piers and passengers buildings have been erected at Newburgh, Poughkeepsie and Albany.

The Hudson River Day Line has more than doubled its service in the lower half of the river by placing the famous steamer Albany in the New York to Poughkeepsie excursion service. It feels perfectly confident in asserting that in service alone there is nowhere in the world its equal for transporting tourist passenger traffic. The Robert Fulton will operate in conjunction with the Hendrick Hudson, and will be a most notable addition to the Hudson river fleet of pleasure steamers.

VERDON SHIP YARD SOLD.

The entire interests of the Frederick A. Verdon Co. had a modest Verdon shipyards, dry dock and marine machinery business at West New Brighton, Staten Island, have been purchased by the Waters, Gildersleeve, Colver Co., which will in future operate the yards. The Frederick A. Verdon Co. had a modest beginning in 1886, in Jersy City, N. J., removing later to Hoboken. Six years ago the plant was transferred to the present site at West New Brighton, a desirable location having been obtained at this point with over 600 ft. of water front.

George H. Waters, president of the Waters, Gildersleeve, Colver Co., was for nearly 20 years identified with the floating equipment department of the Pennsylvania Railroad, where he reached the position of chief draftsman and assistant master mechanic.

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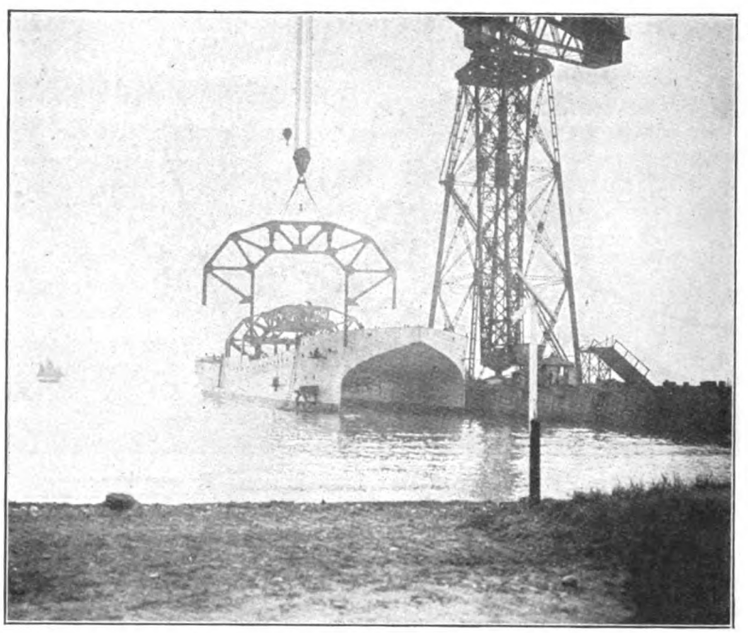
During the past six years Mr. Waters has been superintendent of the Verdon yards.

David H. Gildersleeve, vice president of the company, has had considerable experience in the pumping, hydraulic and gas engineering field. During the Spanish-American war, and for some time after its close, he superintended the construction of the new sewerage system of the city of Havana as a first lieutenant in the United States corps of engineers. For the past five years he has been connected with the C. W. Hunt Co., makers of coal carrying machinery.

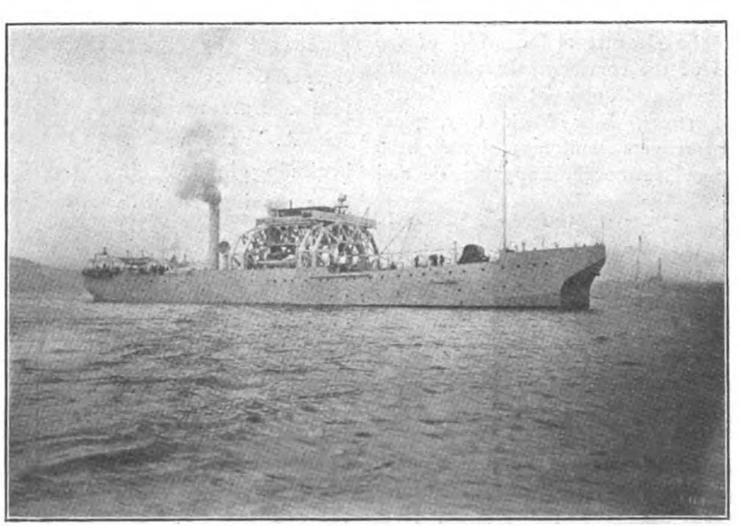
Frederick L. Colver, secretary and treasurer, was for many years president and controlling owner of the Frank Leslie Publishing Co., and later has been a part owner of the Success and American magazines.

German Naval Dockship Vulkan

A SHIP of great interest is the dockship Vulkan, which has recently been placed in commission in the German navy. It has been built in accordance with the plans of the Imperial naval constructor, Ph. von Klitzing, of Kiel, by the Howaldtswerke at that place. The distinguishing feature of the Vulkan is its peculiar form. The vessel itself consists primarily of two hulls, both resembling ships linked together fore and aft above the water line by steel girders made up of angles and plates. This linking or joining together is done in such a manner that a torpedo boat or submarine riding at the surface can steam between the two hulls. When the small craft is in this position tackles and crane hooks can be lowered from the dockship, and the little vessel can be lifted out of the water and docked. After that, from both of the inner sides of the dockship, beams are swung under the smaller vessel, so as to form a platform on which she may rest. The beams are fastened by hinges to the inner side of the dockship. That is to say, they are fastened to the inner side of one of one of the other hulls, and are pulled up against the inner side of the other hull as far as is advisable to raise the docked boat. These beams play no actual part in the raising of a vessel, that action being performed wholly by the cranes and tackles on the dockship. The center of the dockship is free, and the submarine or torpedo boat may be raised as far out of the water as desired. The hoisting or lifting apparatus is arranged on two double portals or bridges built up of lattice girders, the bases of which girders rest on the decks of the two hulls. These girders also serve as a rigid connection between the two hulls.



GERMAN NAVAL DOCKSHIP VULKAN.



GERMAN DOCKSHIP VULKAN.

The means of propulsion of the vessel are interesting, for neither reciprocating engines nor turbines but electric motors are employed for driving the two propeller shafts. Current is delivered to the motors by two independent turbine generator sets. If the vessel is to steam slowly one generator set only is run. All the switches and controlling mechanism for the entire machinery are operated from the bridge, so that no inter-communication between the commanding officer and the engine room is necessary. Steam is

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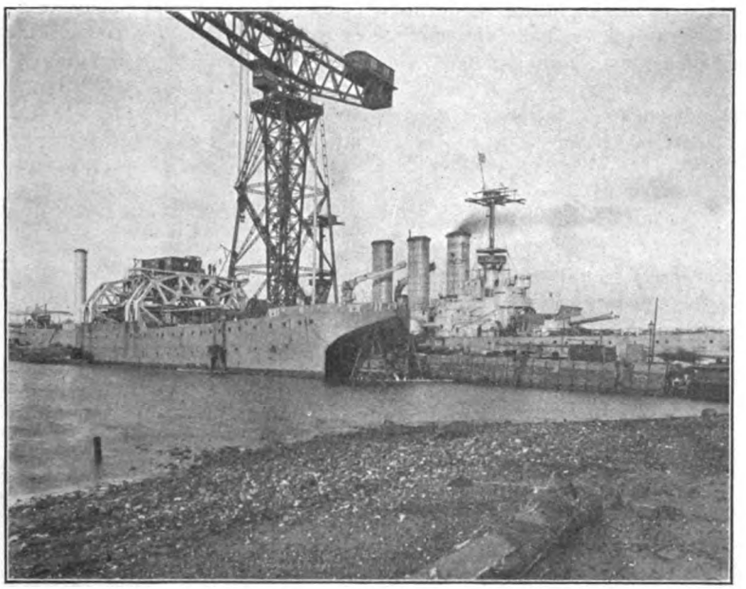


GERMAN NAVAL DOCKSHIP VULKAN.

generated in four Mehlhorn water-tube boilers.

One of the purposes for which the vessel is destined is to serve in salvage operations for sunken submarines, the necessity for such a salvage ship having become more and more apparent as the development of submarine practice has progressed. The trials of the ship have been very satisfactory—so much so, in fact, that a second and larger ship of the same type is under consideration for the other great German naval bases.

EXPERIMENT IN SHIP DESIGN.

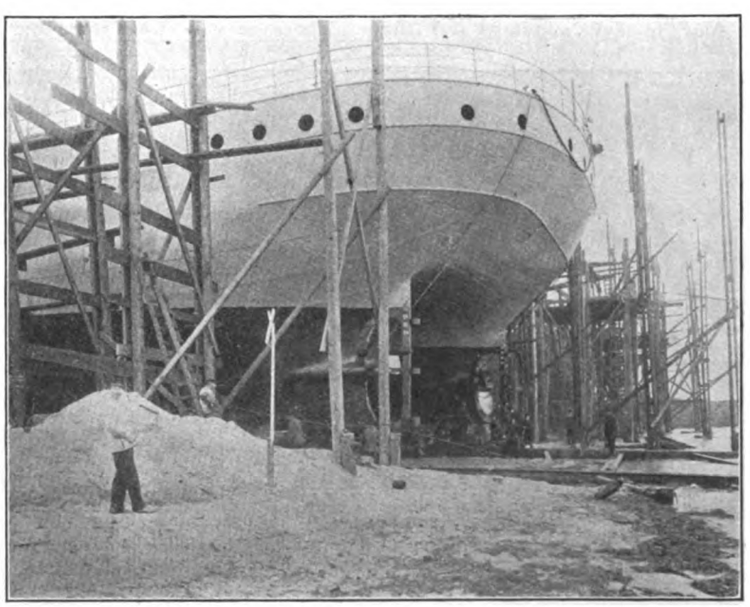
At the meeting of the Manchester society of engineers, held on Saturday, Feb. 26, Mr. Leslie Denny, of Dumbarton, read a paper on the general principles in the design of modern ships. Tonnage, he said, was somewhat of a mystery to those unconnected with ship building and shipowning. Broadly, gross tonnage was the entire internal capacity of the vessel taken in cubic feet and divided by 100, while the net tonnage was that figure less deductions for machinery space, crew space, light and air for machinery, etc. He explained the methods by which data of design were obtained, specially as to weight, capacity and speed. When dealing with speed and power, he said, especially where a departure had occurred from anything previously done, another factor was introduced, and that was the data got from the experimental tank.

In the case of his own firm, this was a canal 300 ft. long, 22 ft. broad, of a depth of 10 ft. Over it there was a pair of rails, on which ran a carriage, and attached to this carriage was an accurate model of the ship immersed in the water to her correct designed draught. The truck was driven along by means of electric power at suitable speeds, and by somewhat elaborate calculations the resistance of the model was obtained. This resistance was then translated into resistance for the full-sized ship, and by that means a curve was obtained of what was called the effective horsepower, or the horsepower that would be necessary to tow the ship.

The difficulty of deciding the power necessary in the ship to drive her at a given speed only began at this point, because it was found that this power necessary was considerably greater than the effective horsepower, sometimes as much as double or even more. Theory alone, unless backed up by ample practical experience, was of very little value in fixing the efficiency. In the case of an exceptionally fast vessel small differences in propellers often made large differences in the results, and even after the builders had done all they could, they were only perfectly happy in the case of the fast vessels when the first double run on a measured mile confirmed their calculations.

MODIFIED PLANS FOR PEARL HARBOR DRY DOCK.

The dry dock at Pearl harbor, Hawaiian islands, was described in the MARINE REVIEW of March 25. The navy department, through the bureau of yards and docks, has now prepared revised plans and specifications for this dock. Proposals for this work were opened Dec. 1 last, but have been rejected owing to lack of sufficient funds, for the construction of a dock 1,200 ft. long as contemplated by the department. A revision of the plans shortening the dock to 620 ft. has therefore been made. All the features of the former design have been retained excepting that where formerly there were two docks in one, an inner and an outer, with a caisson between them, in the new design there will be only the outer dock. The structure will be built in such a way that at any future time it may be lengthened by the addition of the inner dock. To accomplish this the side walls of the dock will be built exactly as if the long dock were to be constructed, and a concrete wall will be built across the head end, forming a closed basin. This concrete cross wall or head is to be



STERN VIEW GERMAN NAVAL DOCKSHIP VULKAN.

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built in such a manner that it can be easily removed, while at the same time its construction is such that it will last as long as the balance of the dock in case congress does not authorize the lengthening of the dock at some time in the future. The dock as now designed will take the largest battleship built or contemplated. Bids for constructing the dock will be publicly opened at the navy department on May 22 next.

Unique Rhine River Electric Ferry Boat

FIG. F.

BETWEEN the towns of Godesberg and Niederdollendorf, Germany, on the river Rhine, an electrically operated ferry boat has been placed in operation licensed to carry about 650 passengers and four carriages or other vehicles.

This electric ferry boat is nearly 100 ft. long and about 30 ft. wide, drawing less than 3 ft. of water. The height to the main iron deck is about 6 ft., and the length of the free deck about 50 ft., its breadth being about 31 ft. This boat, shown in the accompanying illustration, Fig. 1, is constructed of Siemens-Martin steel, and is provided with a storage battery room, an electric motor power compartment and a cabin with bunks for the crew. The time required for this electric boat for crossing the river Rhine between these two cities is from four to five minutes, and the average current used by the port motor is 137 amperes and by the starboard motor 142 amperes.

There is a landing stage on either side of the river consisting of a pontoon about 16½ ft. wide by 53½ ft. long, connected to the shore by means of a bridge 82 ft. long and 26 ft. wide, on one side of the river, the bridge being about half this width on the other side of the river.

The accompanying illustration, Fig. 2, shows the landing stage on one side with connections for charging the electric ferry boat, the plug contact being noted for closing the electrical circuit for charging the latter, which is seen in the accompanying illustration, Fig. 3. In this storage battery room, which is ventilated by a number of offset pipes and port holes, there are 160 cells, the elements being enclosed in vulcanite cases. The batteries are arranged in 16 sets of 10 each, a wooden trough holding each complete set. The pressure is about 300 volts and the capacity of the storage battery on a one-hour discharge, is 335 ampere hours.

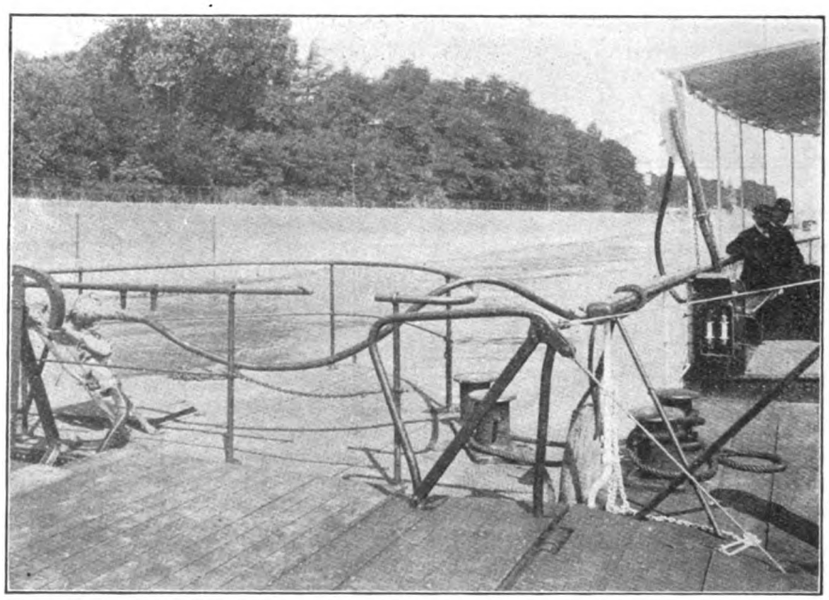

FIG. 2.—LANDING STAGE WITH CONNECTION FOR CHARGING ELECTRIC RHINE FERRY-BOAT SHOWING PLUG CONTACTS.

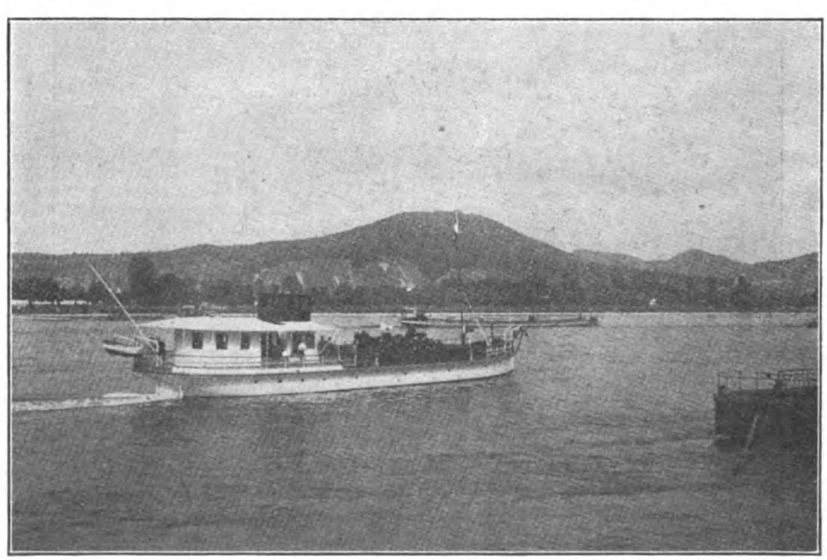

FIG. 1.—NEW GERMAN ELECTRICALLY DRIVEN FERRY BOAT ON RIVER RHINE.

The accompanying illustration, Fig. 4, shows one of the two 50-horsepower motors of the interpole series types constructed at the Lahmeyerwerke at Frankfort-on-the-Main, for driving the propeller shaft.

The two screws operate at a speed of 300 revolutions per minute and the motors driving the same are of light compact construction, the magnet frames being of cast steel. By means of the commutating poles it is possible to vary the speed within very wide limits without causing sparking at the brushes, and to reverse the direction of rotation instantly without evil effects.

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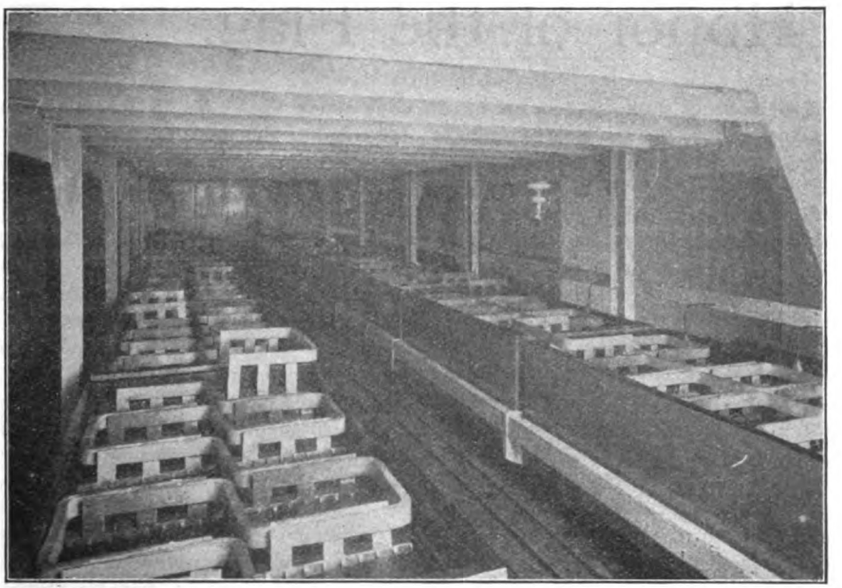

FIG. 3.—STORAGE BATTERY ROOM OF RHINE RIVER ELECTRIC FERRY BOAT.

The main fuses and desk panel switchboard as well as the controller for handling the gangway motors may be seen in illustration Fig. 5, while Fig. 6 shows the interior of the same pilot house and the arrangement of the starting levers and the reversible controllers.

In this navigating cabin all of the necessary operations of the boat propelling motors and landing motors may be controlled. It will be noted that the two reversing controllers are mounted on the wall of the pilot house and operated by chain gearing, with levers so arranged that a forward or backward motion caused the corresponding propeller motor to start in one direction or the other.

At the top of the freight handle lever there is a stub which may be pressed down with a catch for locking the two levers in which case both motors are operated together. The two overload circuit breakers for the two-motor circuit are noted in the ceiling of the pilot house. The two small motors of 3-horsepower each for operating the landing gangways are enclosed in a wooden casing in the battery room and these motors are handled by a third controller installed in the pilot house. The electrically operated hinged landing gangways are about 26 ft. long and 3 ft. wide, and are constructed of iron boarded with pine and fastened to the side of the boat, forming a continuation of the guard railing which encircles the deck, these gangways being raised and lowered by the 3-horsepower motors rapidly when desired from the pilot house. The boat is lighted throughout with electric lamps, the cabin being plain but neat in construction and finish, about two score of incandescent lamps being distributed in the various parts of this electric ferry boat.

A small electric-driven pump is provided for pumping out the boat, it being capable of delivering about 1,000 gallons of water per hour. Before the electric ferry boat was placed in operation the cross river traffic was handled by a cable ferry which caused considerable annoyance to the other users of the river Rhine, frequently obstructing this German waterway. The battery on the electric ferry boat is charged with current from the Godesberg electric light and power station on the left bank of the river, and armored cables being provided for making the necessary connections with the battery journals on the boat, the construction of the terminals of the e charging cables being indicated in the accompanying illu tration, Fig. 2.

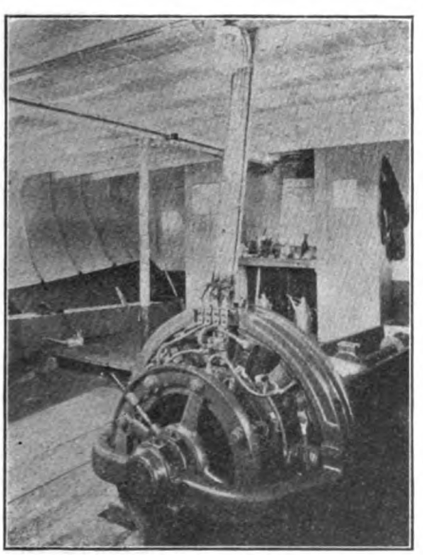

FIG. 4.—50 H. P. INTERPOLE ELECTRIC MOTOR.

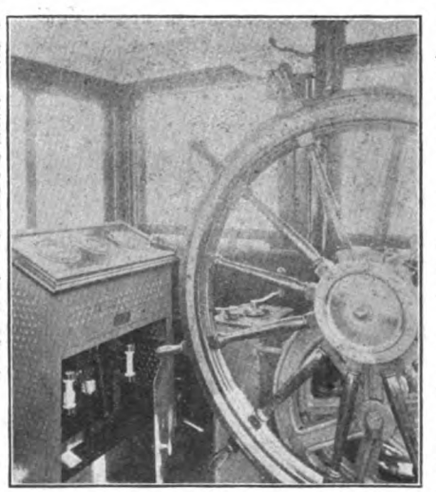

FIG. 5.—PILOT HOUSE SHOWING MAIN FUSE, CONTROLLER FOR LANDING GANGWAY.

NEW PACIFIC COAST LINE.

A new steamship line has been organized at Portland, Ore., to operate a fast freight and passenger service between that city and San Francisco and it is reported that two vessels have been purchased from the Metropolitan Steamship Co., of New York, to take care of the traffic which may offer. The new line, it is said, will operate in connection with the North Bank Railway, which connects with the Great Northern and Northern Pacific. A traffic agreement is to be entered into which will give J. J. Hill entrance into San Francisco territory and the Hill and Harriman interests will thus become active competitors there for the first time.

MALLORY LINER'S FAST TIME.

The Mallory Line steamship Brazos arrived at New York from Galveston recently after having made the passage in 4 days 15 hours and 15 minutes, thus breaking all records between the two ports. The best previous time was made by the Brazos on her maiden voyage last October when she covered the distance in 4 days 18 hours and 40 minutes. The managers of the line declare that the Brazos is capable of making a still better record.

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For the Honor of the Flag.

THE annual meeting of the Merchant Marine League of the United States was held in the rooms of the Chamber of Commerce at Cleveland on Saturday, March 27, and was attended by many distinguished men from all parts of the country. The defeat of the Ocean Mail bill in the last congress has only had the effect of stimulating the league to greater energy. Two sessions were held in the Chamber of Commerce rooms, each marked with earnest and convincing addresses. The meeting concluded with the annual dinner at the Hollenden on Saturday night.

J. G. Butler Jr., of Youngstown, president of the Merchant Marine League, presided at both sessions. At the morning session addresses were delivered by Congressman Richmond P. Hobson, of Alabama, Congressman Charles B. Landis, of Indiana, and James T. McCleary, former assistant postmaster general.

Mr. Hobson spoke of the need of auxiliaries for the navy and of the lively interest which the south has in its export trade. He said that the south keenly felt the lack of facilities for getting its cotton abroad. As for naval auxiliaries there was only one way of keeping them up to date and that was through an adequate merchant marine.

Mr. McCleary spoke with conviction of the needs of adequate mail service. He made a thorough study of the subject during his tenure of office as assistant postmaster general, having had charge at that time of oversea delivery of mails, and realizing keenly how inefficient were the government sources of delivery.

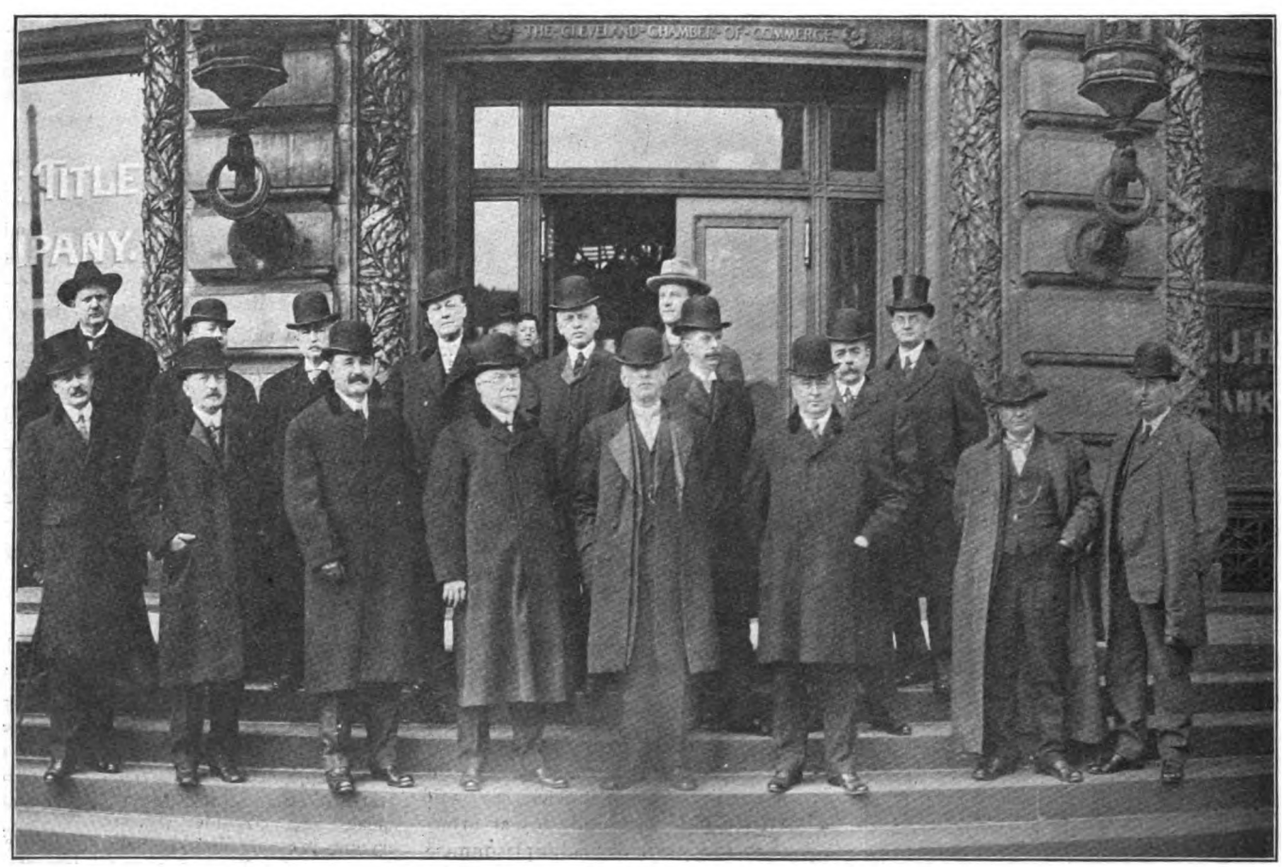
Congressman Landis urged that a campaign of education be waged throughout the country, believing that once the people interested understood the subject thoroughly they would demand that it be solved.

At the afternoon session speeches were made by Leslie M. Shaw, former secretary of the treasury, and Congressman William E. Humphrey, of Seattle.

Secretary Shaw also urged the importance of education and pointed to the Chautauquas as a neglected field. He thought the Chautauquas offered the surest and most direct means of reaching the people. He held congress to be eager to pass bills which it believed the people wanted. He declared that the people would want a merchant marine as soon as they were made to realize its necessity.

Conditions on the Pacific.

Congressman Humphrey spoke of conditions now obtaining on the Pacific coast where only one steamer is engaged in oversea traffic flying the American flag. The rest have succumbed to the unequal conditions imposed upon them by the subsidized marine of Japan and other countries. He felt that greater than the loss of ships was the loss of national self-



MEMBERS OF MERCHANT MARINE LEAGUE ON THE STEPS OF THE CHAMBER OF COMMERCE.

Bottom row, reading from left to right—Congressman J. Sloat Fassett, Daniel J. Sully of New York, Congressman W. E. Humphrey, Former Congressman James T. McCleary, Former Secretary of the Treasury Leslie M. Shaw, Congressman Landis, Mr. J. G. Butler Jr., president of the Merchant Marine League, and H. W. Rose, Leavenworth, Kansas.

Top row, reading from left to right—John A. Penton, secretary Merchant Marine League, Cleveland; Walter S. Russel, Detroit; W. C. Dickey, Indiana Harbor; C. H. Gifford, Detroit; unknown; Congressman Richmond P. Hobson, W. B. Liverzey, Newport News, Va.; Winthrop L. Marvin, Boston, Mass.; Eugene Tyler Chamberlain, commissioner of navigation, Washington, D. C.

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respect. There was no pride to be derived from the fact that the battleship was accompanied around the world by foreign colliers, any one or all of which could have been withdrawn at any time by their respective governments. While he did not believe that war with Japan would ever occur, he nevertheless thought the best safeguard for continued peace was preparedness.

Regarding the extension of coastwise laws to embrace the Philippine Islands Mr. Eugene Tyler Chamberlain, commissioner of navigation, who was present, did not think legislation to this end possible at present.

Secretary John A. Penton read a newspaper clipping to the effect that Congressman Pollard was in danger of suffering a rebuke from the legislature of his own state for his advocacy of the shipping bill. Upon his motion the executive committee was instructed to inquire into the circumstances and to lend its moral support to Mr. Pollard.

Resolutions Adopted By Committee.

The following resolutions were adopted by the executive committee:

Resolved, That we pledge renewed co-operation with patriotic citizens of all parties, in all sections of the country, in an unceasing effort to secure national legislation for the upbuilding of American shipping in the ocean trade. We commend the patriotic statesmanship of the senators and representatives in congress who have supported this movement, the question we believe to be the most important now before the American people. It aims to make efficient our navy, of whom every citizen is justly proud, by providing adequate colliers, transports and other auxiliaries, important in times of peace and imperative in times of war.

No interest will be benefited more than agriculture, which feeds the artisan, whose product can successfully compete in foreign markets only when transported in American bottoms and freed from discriminative rates imposed against it by ships subsidized by foreign countries. In addition to this, more than one-half of our exports consist of farm products.

The Isthmian canal will prove its worth to the American people only in proportion as they make use of it through an adequate merchant marine to secure for American agriculture and American manufacture their share of the more than one thousand million of imports consumed in countries washed by the Pacific ocean.

Resolved, That we deplore the condition of our merchant marine, which causes American material to Panama, coal between American ports for the use of our navy, and our mails and military supplies for the Philippines to be carried under foreign flags.

Resolved, That it is the sense of this league that the government afford every reasonable encouragement to American shipping, not only to our outlying possessions, but especially to Panama, where we are now prosecuting the most important and far-reaching enterprise which any nation has ever undertaken.

Resolved, further, That we urge upon commercial and patriotic bodies everywhere that they begin at once and actively prosecute an educational campaign upon this subject. No question is more appropriate, and none more worthy.

Some Brilliant Speeches.

The banquet at the Hollenden which marked the close of the sessions was a brilliant affair. Seated at the speakers' table were former Secretary Leslie M. Shaw, Congressman J. Sloat Fassett, former Governor Myron T. Herrick, Congressman Richmond P. Hobson, former Congressman James T. McCleary, Congressman William E. Humphrey, Congressman Charles B. Landis, Commissioner of Navigation Eugene Tyler Chamberlain, Daniel J. Sully, of New York, Harvey D. Goulder, of Cleveland, Walter S. Russel, of Detroit, Ambrose Swasey, of Cleveland, William C. Dickey, of Indiana Harbor; H. A. Rose, Leavenworth, Kas.; J. G. Butler, Jr., of Youngstown, Geo. H. Barbour, of Detroit, Charles S. Howe, of Cleveland, and William P. Murray, of Cleveland.

Mr. J. G. Butler, Jr., introduced Col. J. J. Sullivan, president of the Central National bank of Cleveland, as toastmaster of the evening. Col. Sullivan, after proposing a toast to the president of the United States, introduced Mr. Leslie M. Shaw as the first speaker of the evening.

Address of Leslie M. Shaw.

Mr. Shaw's address was a direct plea for the encouragement of commerce. He held this to be the true American sentiment and showed that coastwise commerce had been encouraged by reserving it to the American ship, that the building of railroads have been encouraged by the grants of lands, that manufacture had been encouraged by protective duties. The one thing that had not been encouraged, which had, in fact, been compelled to operate under the artificial handicaps imposed by our fiscal policy, was the American ship in the oversea trade. By reason of this policy the American ship is practically unknown in foreign ports and some South American countries do not even know that the United States is on the map. He thought it strange that the United States should spend millions to develop its harbors and withhold the money needful to enable the American ship to utilize them. He also deplored our lack of transports and colliers as a supplement to the navy. His address dealt with facts and as such was direct and convincing.

Congressman Hobson's Recital.

Congressman Hobson followed Mr. Shaw. He spoke of the need of the navy. As the leading figure in one of the most dramatic incidents in the Spanish-American war what he said was listened to with the closest attention. His recital of his imprisonment at the fortress of Santiago and the impression made upon him as from his window after may weeks, he saw the Spanish flag descend from the fortress and the United States flag take its place evoked thunderous rounds of applause. His plea was for preparedness, for ability to defend our rights at all times and in all places. He is a consistent advocate of a large navy with an auxiliary marine commensurate.

Mrs. Seabury C. Ford sang "The Star Spangled Banner."

Colton Is Our Greatest Asset.

Mr. Daniel J. Sully, of New York, spoke of the immensity of the cotton trade, which he held to be the commodity that will eventually maintain American supremacy among nations. Ore and coal does not renew in the ground, the lumber supply could become exhausted, but cotton annually renews itself. Concerning it he said:

"The future of American supremacy over sea is not to be based on corn and wheat or beef, for our great food products, before many years, will be consumed at home by our vigorous American millions. What is it that must make America pre-eminent? What does America produce, and America alone, in sufficient quantities, which civilized mankind calls for and upon which the progress of the world incontestably depends? Cotton. ..

"Such a commodity is produced in these United States. Cotton is America's greatest asset, more priceless than its gold, that is to be the heritage of our people forever.

"If you will concentrate your energies upon our chief commodity—cotton—which you, as Americans, must ultimately do, the ships to carry this great commodity, both in its raw and manufactured states, will spring into being, and our great government will lend its powerful aid, just as in the past it has given substantial encouragement to transcontinental lines, when the leaders of that industry concentrated upon solving the transportation problems of the New World. America should plow all seas for the farmer who plows American soil."

Favors Direct Subsidy.

Congressman J. Sloat Fassett spoke in favor of a direct subsidy. He ridiculed the idea of war with Japan and put the question upon other grounds wholely. He thought that this country could not compete in oversea shipping with the ships of other nations unless the handicaps imposed by the protective tariff were compensated by direct aid.

The concluding speech of the evening was made by Harvey D. Goulder, the first president of the Merchant Marine League, who was greeted with great applause, many rising in their seats to cheer him when he rose to speak. Mr. Goulder declared that everyone present should dedicate himself to renewed efforts for the restoration of the American merchant marine. He felt that the defeat of the ocean mail bill was only a temporary setback and that a new dawn for the American merchant marine was breaking.

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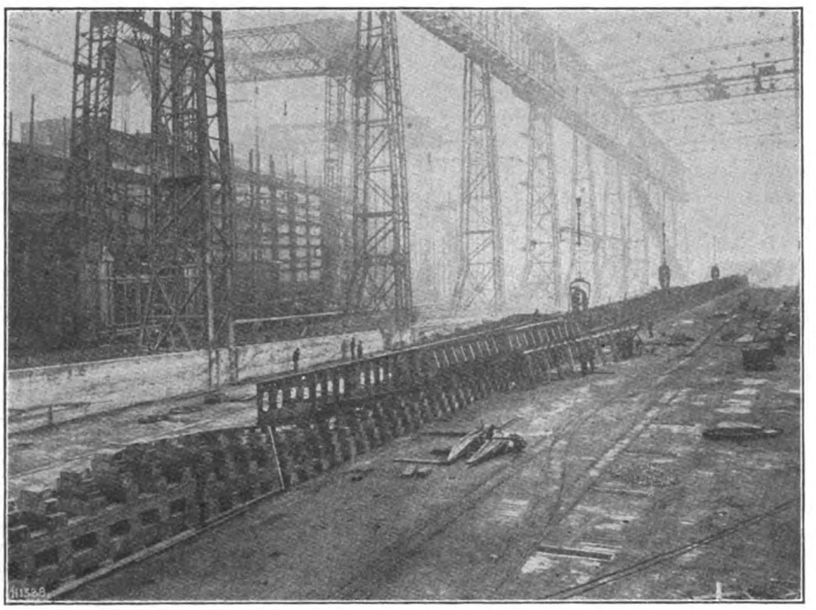

KEEL PLATE OF THE WHITE STAR LINER OLYMPIC.

Olympic and Titanic.

ACTUAL construction work on the new White Star Line seagiant Olympic (45,000) is proceeding steadily at Belfast, and the keel of the companion vessel Titanic will shortly be laid. In the gigantic new twin-gantries—the immense cradles destined to hold these superb vessels—the builders, Harland & Wolff, will rear these two largest steamers ever constructed. The accompanying view is interesting because it illustrates the primal constructive work, that of laying the keel and the keel center plates, which is being accomplished in the most modern fashion by electrical machinery. One improvement along this line is that instead of the noise of the traditional "boiler shop", the thousands of rivets that bind together the 860 ft. of keel plates are being placed without the rat-a-tat-tat so familiar to those who have heard it employed in the construction of steel buildings. This is the more wonderful when it is considered that each riveting machine, weighing over seven tons, is suspended from the gantry frame and managed by two workmen, and is easily moved to any position, either in a longitudinal, athwartship, or vertical position and can be adjusted with the greatest precision. It speaks well both for the White Star Line and the builders that Harland & Wolff in constructing about 50 steamers which have successfully navigated "the seven seas" flying the well-known red pennant with its famous white star, have gained an enviable record of continual progress, each succeeding vessel outstripping its predecessors, and representing the latest and highest attainments in ship building.

BELGIAN ENGINEER HONORED.

P. J. Goetbloet, consulting engineer and president of the Society of Belgian Marine Engineers (Cercle des Mechaniciens de Marine Belge), has again been the recipient of signal honors, having recently been made a Knight of the Order of Leopold, an order granted only for conspicuous service to the country. The official notification bears the signature of the king, and the letter of His Majesty's secretary reads as follows:

By Royal Decree, M. Goetbloet, president of the Society of Belgian Marine Engineers. "It is for me an immense pleasure to have the honor of transmitting to you the orders I have received from His Majesty, King Leopold the Second, promoting you a Knight of His Order....."

A committee of members of the society was formed to arrange for proper recognition of the honor bestowed on its president, the result being that he was presented with a bust of himself in marble. The Shipowner' Federations, Lloyds, Bureau Veritas and other important bodies also took occasion to present suitable tokens of their esteem. In the course of his remarks at the banquet which followed, M. Goe bl et said that he had rather have received the news from Brussels that the Belgian certificate of competency for marine engineers sailing on Pelgian ships had become compulsory, but, nevertheless, he was pleased that the honor had been bestowed on him as president of the society.

M. Goetbloet is member of several prominent engineering and scientific societies and has been the recipient of numerous medals and honors as recognition of his work in the field of scientific research and as consulting engineer. He was largely instrumental in developing the Society of Belgian Marine Engineers.

P. J. GOETBLOET, PRESIDENT SOCIETY OF BELGIAN MARINE ENGINEERS.

The unexpended balance of the fund known as the Geneva Award for payment of the Alabama claims is $11,448.06.

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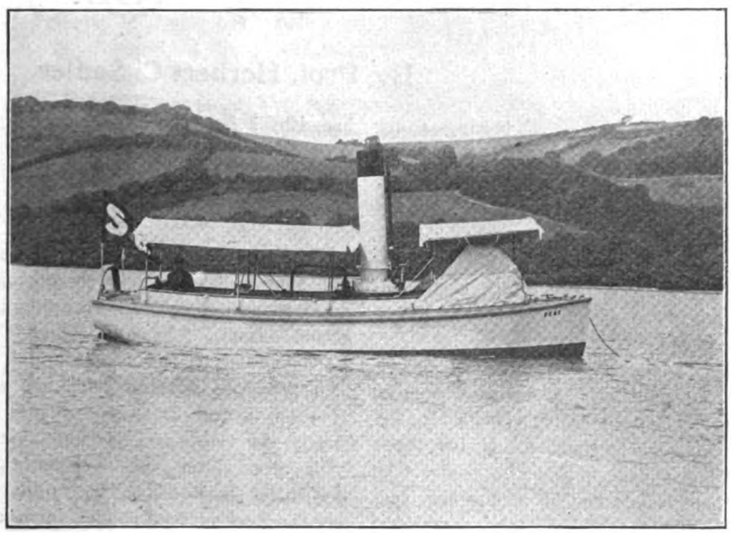
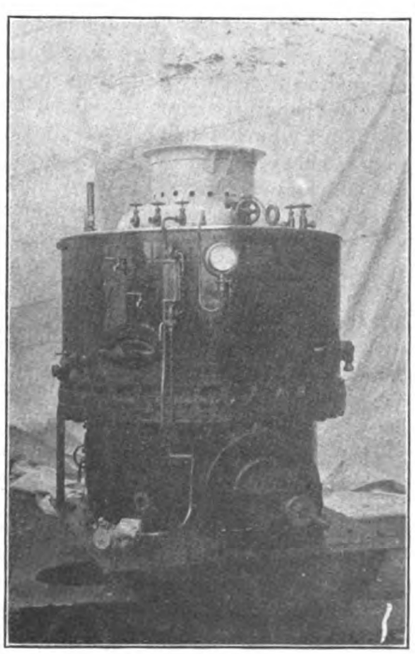
Oil Fired Launches.

THE great point upon which the suction gas plant threatens the supremacy of steam as a motive power for marine purposes is that of economy, which is so considerable as compared with steam as to admit the possibility of the use of the former power for commercial work in spite of its present great disabilities in regard to starting, stopping and reversing. That the makers of steam engines have not been slow to realize the danger, and take steps to counteract it, is evident from the following description of three launches built by Simpson Strickland & Co., Ltd., of Dartmouth, for a large Indian trading house. These boats were required by the owners to tow large barges to the carrying steamers, which have to lie some distance off in the roadstead, and with a view to economy, tenders were asked for launches which could use crude oil fuel, of which a very large quantity is available on the spot. The launches are designed as before stated for work as tugs, to operate in fairly rough and open roadsteads, and to be good sea boats. To this end, though their length is only 27 ft. 6 in. b. p. the molded beam over the frames is 8 ft. with a molded depth of 4 ft. 5 in., so that it will be seen that they are big-bodied craft. The mean draught in salt water was not to exceed 2 ft. 8 in. with one ton deadweight on board. The hull is entirely constructed of galvanized steel, the plating being 2-20 in. thick, the keel is a bar 2 in. by ⅜ in., into which the stern is scarphed; the stem is rebated to protect the fore edge of the plating. The keel is straight, with a 2½ in. by ¾ in. stern post carrying a boss for the stern tube. Two steel water-tight bulkheads are fitted, one forward and one aft of the machinery space, and steel waterways and coamings are fitted right round the boat to assist her in a sea, a teak deck being carried right forward and aft outside the coamings. Forward is the fore peak, closed by a water tight door. Aft of this is a small well from which the boat is steered by means of a wheel. Then comes the machinery space, and aft of this another small well with teak sets. Each boat is fitted with a pair of strong lifting hooks to enable it to be hoisted in davits, and a strong towing hook mounted on a spring is fitted on the bulkhead aft of the machinery space, and a towing beam on the after deck. To enable the boats better to face the sea, a canvas hood is fitted over the fore well, while as a protection against the sun, canvas awnings are spread over the well on galvanized stanchions. To come now to the machinery, the specifications called for engines capable of indicating not less than 35 H. P. on service, at not more than 420 revolutions. The builders supplied their standard compound surface condensing engines having cylinders 5 in. and 10 in. by 6 in. stroke, with a working pressure of 150 lb., the revolutions on trial being actually about 330. The cylinders are carried on cast iron back frames with turned steel front columns; the valves are both flat and worked by link motion of the slotted link type. The air and feed pumps are direct driven off the crosshead of the low-pressure cylinder, while the condenser is of the ordinary inside type of galvanized steel with brass tube plates and tubes, the circulating pump being driven off the forward end of the crank shaft.



OIL-FIRED LAUNCH BUILT BY SIMPSON, STRICKLAND & CO., DARTMOUTH, ENGLAND.



BOILER OF OIL-FIRED LAUNCH BUILT BY SIMPSON, STRICKLAND & CO., DARTMOUTH, ENGLAND.

Unusual Type of Boiler.

The boiler, which is probably the most interesting part of the whole installation, presents several features of a somewhat unusual type. Generally it is of the Kingdon vertical fire-tube type, but as will be seen from the illustration, the water space is not carried down round the fire bars but stops short at the bottom tube plate. Further as the boiler has to be used in parts where the water is very impure, the outer shell is secured to the inner part, which carries the tube plates by studs, so that the boiler can be entirely dismantled for cleaning purposes without disturbing the tube plates.

As has already been stated, the fuel to be used is Indian crude oil. This has a specific gravity of about 0.914 and a flash point of about 340 degrees Fahr., while the "setting" point is 110 degrees so that, at atmospheric temperatures which obtain generally in these higher latitudes, it becomes practically solid and about the consistency of butter. To keep this therefore in fluid state, to enable it to be burnt, it was found necessary to introduce a system of steam coils into the fuel tanks which are in the wings, and also into the filter which immediately adjoins the tank, while the fuel pipe for its whole

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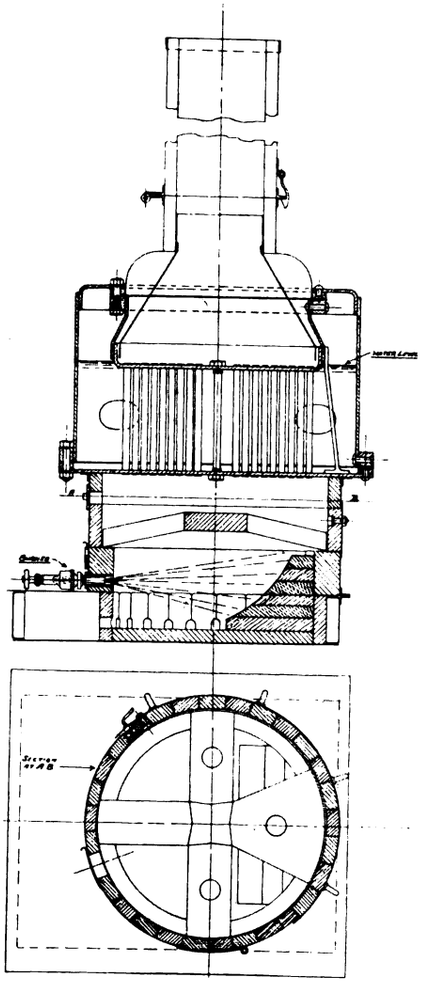
length, from the tank to the burner is steam jacketed. The system adopted for the burner is a steam spray on the principle of an ejector, so that there is no pressure in the tanks, and no pumps are required. The oil in its fluid state passes through the central cone surrounded by steam, and is thus atomized, and is sprayed into the furnace on to what may be termed a "target" of fire brick. Here the jet is broken up and passes through holes in the fire-brick arch on to the tube plate, which is thus protected from direct impingement of the exceedingly hot gases. Air is forced into the ashpan by means of a fan, driven off the main engine by a steel belt, and from the ashpan passes into the combustion chamber through holes in the surrounding fire-brick. The amount of air entering can be controlled by a slide, whilst the amount of steam and oil passing through the burner is also regulated by a stop valve, so that the fire is under complete control and is found to be absolutely smokeless at all rates of combustion.



BOILER OF OIL-FIRED LAUNCH.

The official tests called for one hour's continuous run at 40 indicated horse-power, and a one hour's run at 35 I. H. P. with a tow rope attached to the shore and these resulted as follows:

Steam, lbs.	150	150
Vacuum, in.	26	26
Revolutions	333	292
I. H. P.	40.8	35.5
Fuel consumed in 1 hour, lbs.	86.5	70.5
Fuel consumed in 1 hour per I. H. P.	2.12	2
Speed, knots	8.14	7.9

The boats have now been on their station for some six months, and according to the latest reports have been giving complete satisfaction in ordinary working. The hulls of these launches were designed by and the whole of the work carried out under the supervision of Mr. Archibald Hogg, of Newcastle-on-Tyne.

Effect of Bossing on the Resistance of Ships.*

By Prof. Herbert C. Sadler

IN THE course of testing some models of twin screw ships with different shaped sterns, the writer had occasion to try the effect upon the resistance of placing the bossing at different angles, and it was thought that the results might be of interest to the members of this Institution.

Before proceeding to discuss the results obtained in these experiments, the writer would call attention to the important part that some of these appendages might play in connection with the resistance of a modern vessel. Most of the passenger vessels of to-day are fitted with bilge-keels, and nearly all with two, if not, in the case of turbine-driven vessels, three or four lines of shafting. The stream-line flow around a vessel is still somewhat of an unknown quantity, although in a valuable paper by Naval Constructor D. W. Taylor, United States Navy, before the Society of Naval Architects and Marine Engineers in New York in 1907, the probable path of the water has been indicated for a number of different types. A casual glance at these lines will show how easy it is to place an appendage in a most disadvantageous position so far as resistance is concerned; in fact, the resistance might easily be increased 20 per cent by improper design.

The following experiments, although applying directly only to the form tested, nevertheless indicate in a general way the course to be followed in placing the bossing for a twin-screw ship.

The following are the particulars of the model used:—Length, 10 ft.; breadth, 1 ft. 3 in.; draught, 6 in. and 7 in.

Draught	Block Coeff.	Pris. Coeff.	Mid. Sect. Coeff.
6 in.	0.635	0.663	0.958
7 in.	0.653	0.677	0.964

The model was first run "naked" at the above draughts, representing the medium and deep-load draughts in the actual vessel. The bossing was afterwards added to the same model. The two types of bossing tried are shown in Figs. 1 and 2, and represent practically the two extreme cases, viz., one with the appendage horizontal, and the other inclined at an angle of 45 deg. to the vertical. The form of the bossing is that in common use, the top being kept as straight as possible, while most of the curvature is on the underside, an arrangement which gives a more simple construction in connection with the plating than that where both the top and bottom have the same form.

The tests with the bossing were made at the same displacement as that corresponding to the 6-in. and 7-in. draughts of the naked hull. This method was adopted in preference to that of equal draughts as giving a more direct comparison. The difference in draught, due to the displacement in the bossing, is not great, as the additional displacement is only 0.84 per cent for No. 1, Fig. 1, and 0.88 per cent for No. 2 bossing, Fig. 2. The net addition to the wetted surface is about 3 per cent for the horizontal type, and about 3½ per cent for the inclined type. The curves for total resistance are shown in Fig. 3 plotted to a speed-length ratio base, and give the results for both the medium and deep draughts.

Observation of these curves shows that at all practical speeds for this

*Paper read before the Institution of Engineers and Ship Builders in Scotland, Feb. 23, 1909.

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form the horizontal type of bossing is greatly inferior to the inclined type. Notwithstanding the fact that the latter gives an increased wetted surface, between the limits of speed-length ratio of from 0.7 to 0.85 the increase in total resistance over that of the "naked" hull only varies from 3 to a little over 4 per cent, while for the horizontal type the corresponding increase is from 10 to 11 per cent.

The effect of the two systems is, however, better seen by referring to Fig. 4. In this case the residuary resistance is shown for the two displacements, the corrected surface friction in each case having been deducted.

Instead of actual residuary resistance, the resistance per ton of displacement is plotted, and, instead of speed, the abscissae represent speed-length ratio, or speed in knots divided by the square root of the length in feet. Mention is made of this method of plotting because the curves so obtained are independent of size or density of water, and will apply to any ship of which the model is a type. This has been adopted as the standard method of plotting residuary resistance both at the University of Michigan and at the United States government tank at Washington, and is the simplest form for direct application to practical problems.

Within the limit of speed-length ratios before mentioned, the inclined system of bossing for the two displacements increases the residuary resistance by a very small amount, which at some speeds is negligible, while in the horizontal type the increase averages from between 30 and 35 per cent.

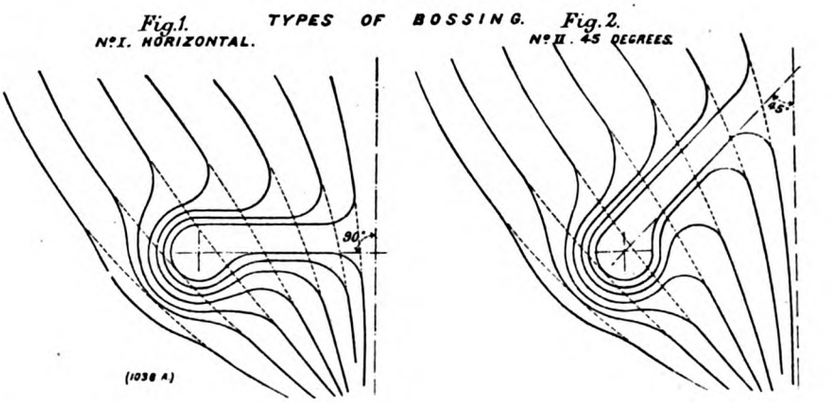
Comparing the curve of residuary resistance for No. 2, or the inclined bossing with that of the "naked" hull, it is obvious that the stream-line flow cannot have been materially changed in the two cases. This conclusion, to a certain extent, bears out Taylor's stream-lines, and if the buttock-lines of No. 1 be compared with those of No. 2 and also with the "naked" hull the result is, perhaps, only what might have been expected.

The above experiments give, however, quantitative results for purposes of comparison, and emphasize the importance of attention to such details as designs.

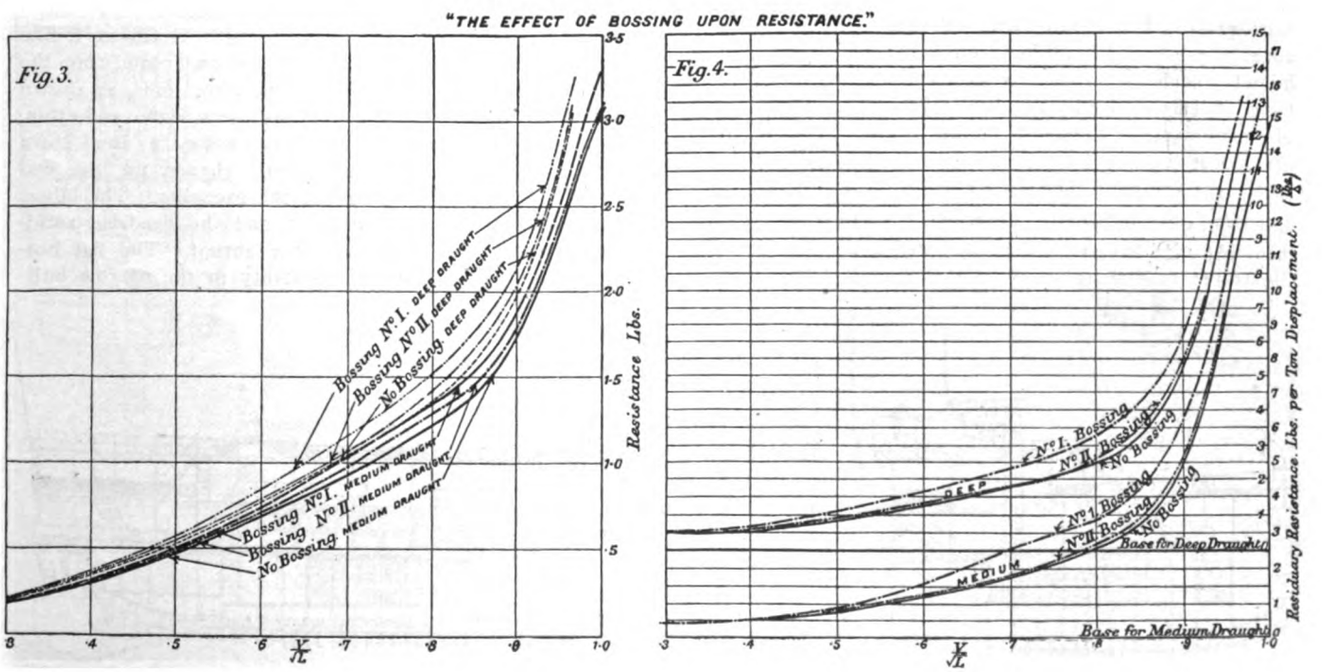
Attention may also be called to the fact that a number of fast Atlantic liners have been fitted with horizontal bossing.

FOUR BLADES FOR LUSITANIA.

The Cunard liner Lusitania is soon to be dry docked at Liverpool, where she will be fitted with four-bladed propellers instead of the three-bladed ones with which she is now equipped. This will be done with a view to increasing her speed as the results obtained by a like change on her sister ship Mauretania were very satisfactory and she has since been breaking all records on her trans-Atlantic trips.



"THE EFFECT OF BOSSING UPON RESISTANCE."



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FROM THE PACIFIC COAST

Steel Passenger Steamer H. B. Kennedy.

Designed for Fast Daylight Service on Puget Sound.

FIG. 12.

GRADUALLY, out of the chaos of primitive and rapidly changing conditions, there are emerging on the Pacific coast a number of standard types of vessels adapted to the peculiar conditions found on the waters of the far west. In previous articles in the MARINE REVIEW the writer has traced the development of a standard type in the steam lumber carriers of the Pacific coast. The same evolution is going on among the passenger steamers. After some years of experiment with designs copied from boats operated in other parts of the country under different conditions, after several trials with old boats imported from the Atlantic or the great lakes and after three decades of experience with Pacific coast passenger traffic on the inland harbors and rivers, there have been evolved standard types of passenger steamers, built on the coast and designed to suit the local conditions. The stern wheel steamer Inland Empire described in the MARINE REVIEW, Feb. 4, 1909, illustrates one of these types.

As an example of an entirely different type we present in this article a description, with plans and illustrations, of the new Puget Sound passenger steamer H. B. Kennedy. The description of the Kennedy is worth while, not only because she is in herself an excellent craft and a credit to marine engineering, but because she represents the best of a whole fleet of boats, commencing with the old Flyer, still operating between Seattle and Tacoma, designed for fast daylight service on Puget Sound. The H. B. Kennedy is thoroughly typical of her class and will set the pace for some time to come in the design of other steamers intended for similar service.

Rapid Work of Construction.

The steamer was built complete by the Willamette Iron & Steel Works, Portland, Ore., under the direction of Wm. H. Corbett, president, and Bert C. Ball, chief engineer. She was designed by Frederick A. Ballin, naval architect, Portland, Ore. She is owned by the Port Orchard Route, Seattle, Wash., of which H. B. Kennedy is president and principal stockholder. The keel was laid in July, 1908; she was launched Nov. 28, 1908; the builder's trial trip was March 25, 1909; the official trial was March 30, and the steamer was ready for service April 1, 1909.

The new boat will operate most of the time in company with the other steamers of the Port Orchard Route between Seattle, Bremerton and other Port Orchard Bay points, a distance of about 16 miles. Several round trips will be made daily. The traffic is heavy on this route, specially in the summer. The distance is short; part of the trip is through a crooked and rather narrow channel and part is across the open waters of the Sound. The landings are frequent. What is required, therefore, in a steamer for this service is high speed, ease of manipulation in and out of harbors and up to docks, seaworthiness, attractive appearance and complete cabin appointments. The fares are low and economy of operation is consequently desirable. The conditions on this run are quite similar to those existing on several other Puget Sound routes, and are such as to produce a very refined and pure type of steamer.

Details of Construction.

The hull of the H. B. Kennedy is built of steel with five steel arch frames supporting the cabins, which are of wood. The model is very clean and fast. The hull is 190 ft. in length over all, 28 ft. beam on the main deck, 25 ft. water line beam and 12 ft. 6 in. molded depth. The ratio of length to breadth is 6.8 to 1. She has a torpedo stern, round on the main deck. The after lines, as shown in Fig. 6, are very fine and thin, giving a clean wake, a low stern wave and ample chance for the water to reach the propeller. The bilges are quite flat and the deadrise amidships is rather abrupt. The flat bottom gives stability to the narrow hull

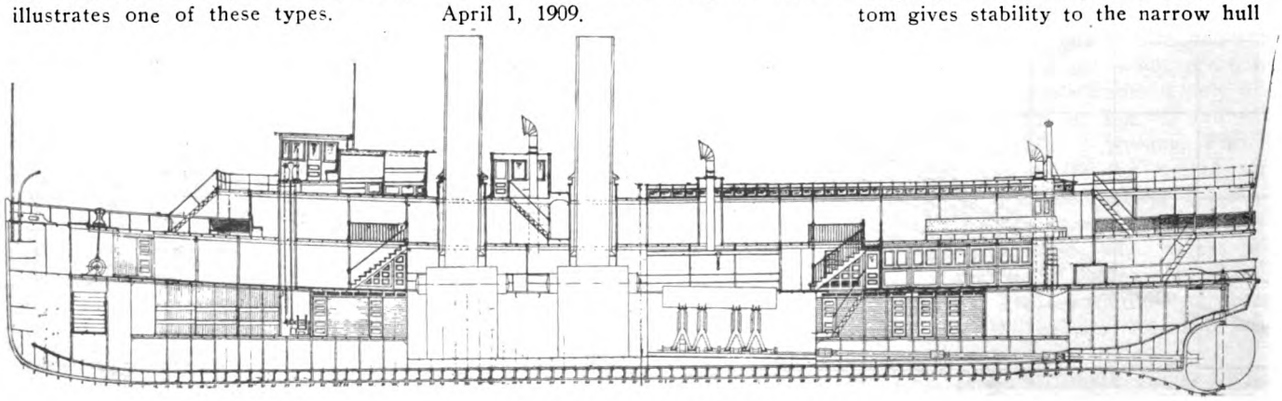

FIG. 1—LONGITUDINAL SECTION OF STEAMER H. B. KENNEDY.

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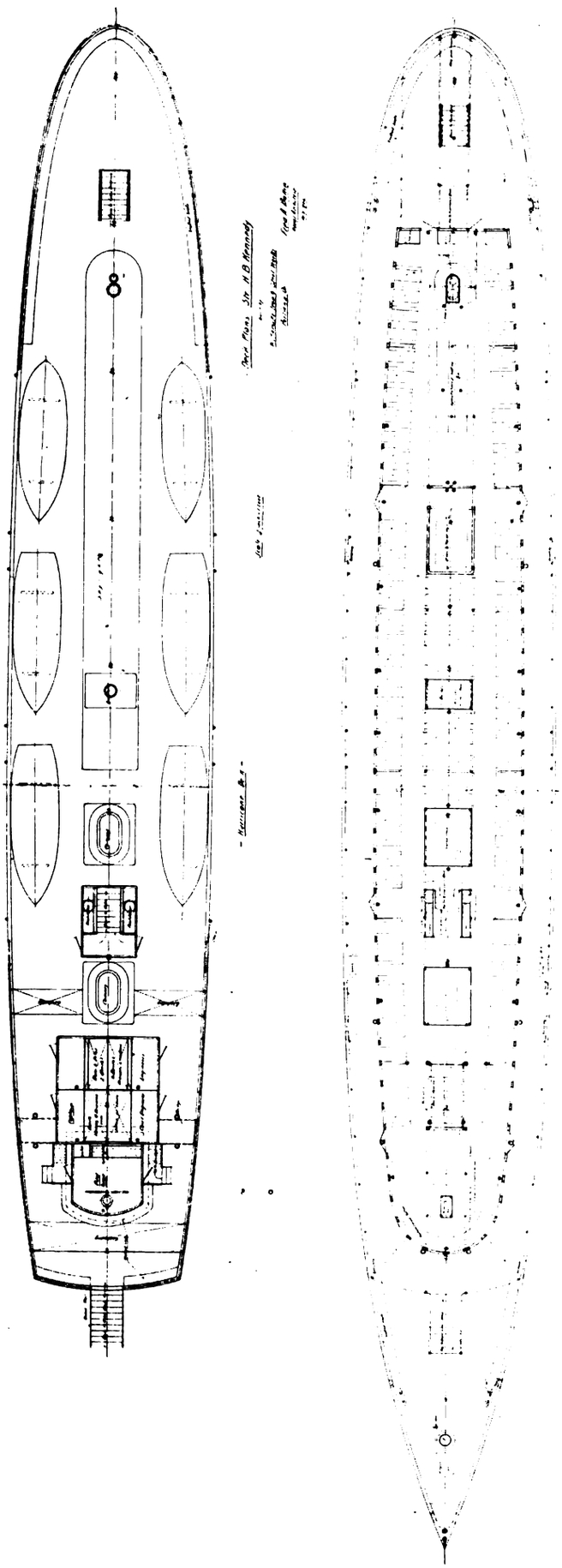

FIG. 2—HURRICANE DECK AND PROMENADE DECK PLANS OF STEAMER H. B. KENNEDY.

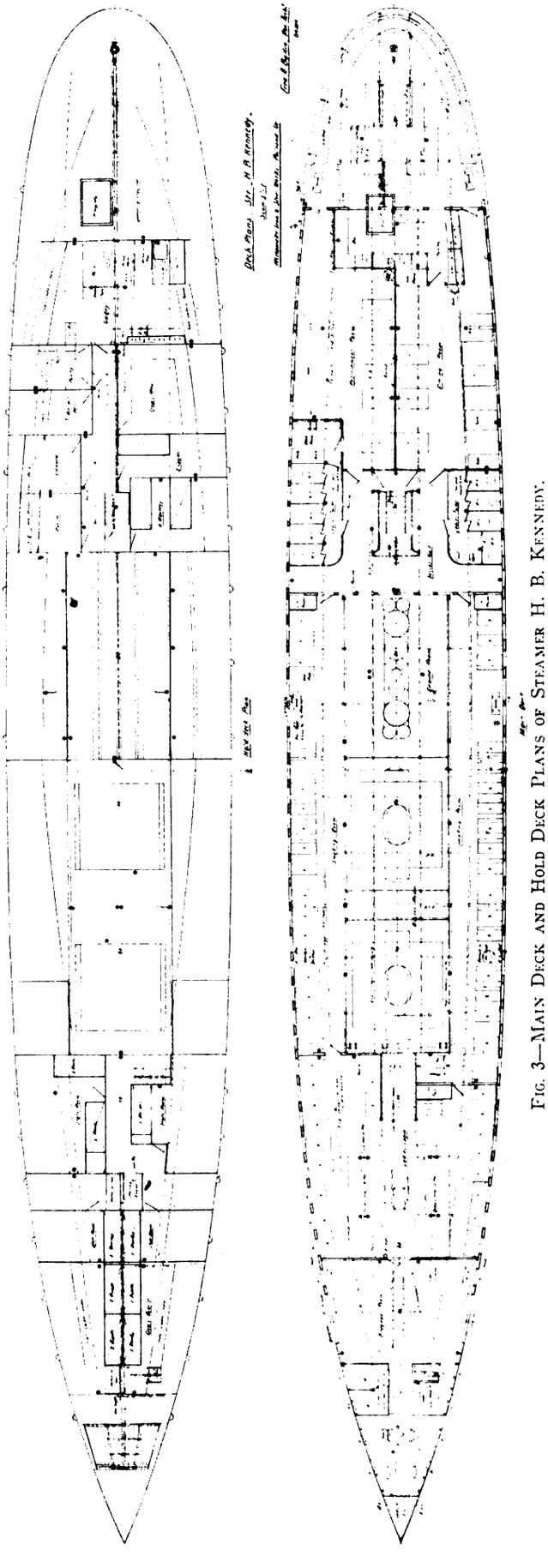

FIG. 3—MAIN DECK AND HOLD DECK PLANS OF STEAMER H. B. KENNEDY.

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without bilge keels. The vessel is much steadier and more seaworthy than her appearance above the water line would indicate. The construction of the frame is clearly shown in Fig 4, which shows cross sections at frame No. 63 and frame No. 75.

Angle irons are used almost exclusively for the frames. Following is a table of the framing:

Main Frames:	3½ x 2½;	4.9 lb.	Frames 1-33, 38-53, 66-98.
	3½ x 2½;	6.1 lb.	Frames 34-37, 54-66.
	3 x 2 ;	4.1 lb.	Frames 99-101 and cants.
Reverse Frames:	2½ x 2½;	4.1 lb.	Frames 14-88.
	2½ x 2 ;	3.7 lb.	Frames 2-13, 88-99.
Deck Beams:	3½ x 2½;	6.1 lb.	Frames 11-32, 64-99.
	3½ x 2½;	4.5 lb.	Frames 33-63, 100-101.
	3 x 2½;	4.5 lb.	Frames 1-10.

Double bottom: 40 in. deep from frames 33 to 53.

Oil bunkers, frames 38 to 53.

Watertight bulkheads at frames 10, 33, 53 and 67.

Engine keelsons, 12½ in. below shaft center. No. 16 plate. Angles, 3½ x 3½; 8.5 pounds.

Stem, 6 x 1¼ in.

Stern frame, 6 x 1¼ in.

Rudder stock, 5½ in. diameter.

As is seen in Fig. 1, there are 100 frames.

There are four decks, as follows: Hurricane deck, promenade deck, main deck and hold deck. The arrangement of these four decks is shown in Figs. 2 and 3.

On the hurricane deck is the pilot house and the texas with accommodations for the captain, mate and pilot, chief engineer and assistant engineers. The six life boats are stowed on this deck. Between the smoke stacks is the main companionway to the promenade deck.

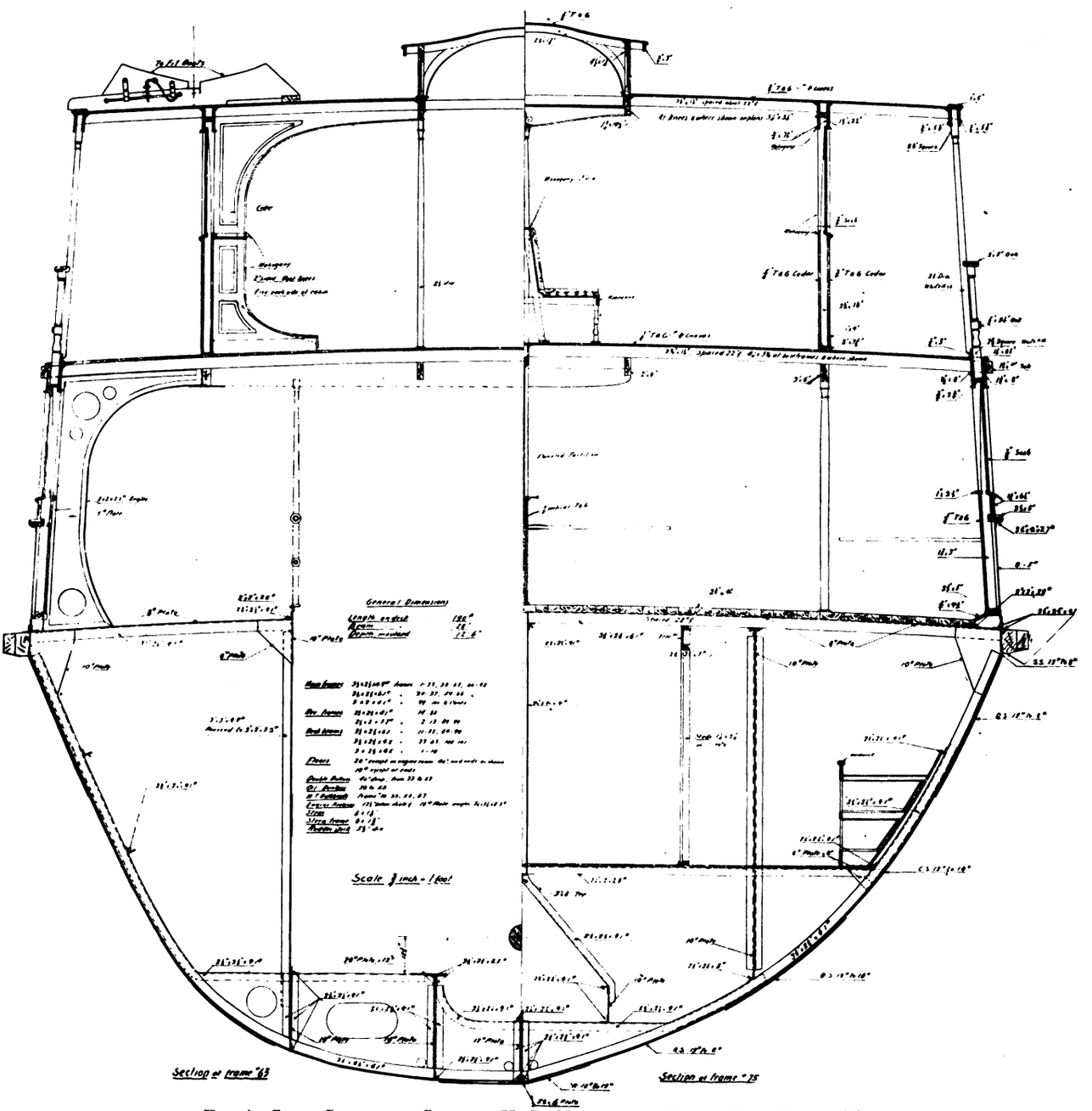

FIG. 4—CROSS SECTION OF STEAMER H. B. KENNEDY AT FRAME NOS. 63 AND 75.

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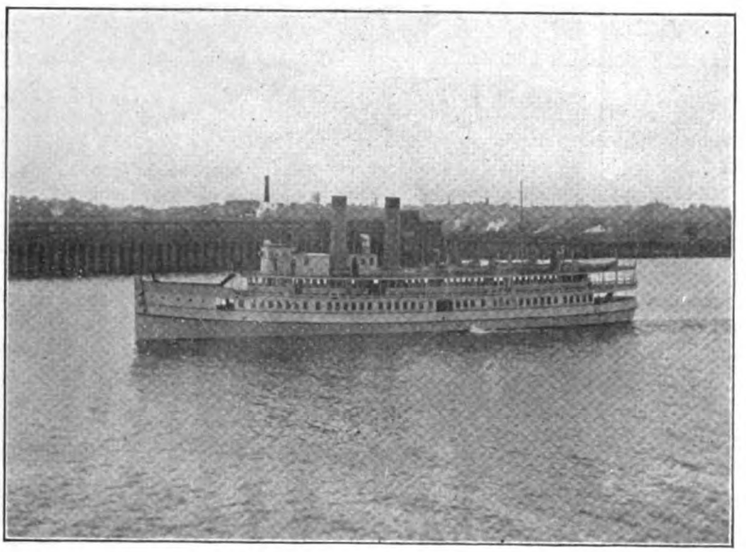

FIG. 5—STEAMER H. B. KENNEDY READY FOR HER BUILDERS' TRIAL.

Design of Main Cabin.

The promenade deck covers the full length of the hull. The main cabin, located on this deck, is 128 ft. long and 19 ft. wide at the center. It is on this deck, which is a promenade deck in fact as well as in name, that the distinctive features of the Kennedy begin to be apparent. Forward of the cabin is 36 ft. of deck provided with slatted seats on either side; aft of the cabin is 25 ft. of open deck with ample seating capacity. The passageways on either side of the cabin are 4 ft. wide. The main cabin, located on this deck, is open from end to end. It is unusually well lighted with large windows all around and with a 64-ft. skylight in the roof. The seats are upholstered in green leather; the interior wood finish is in polished mahogany; the funnel and other enclosures are set off with terra cotta bas-relief panels about 4 ft. square. The ceiling is white enamel. The entire effect is very pleasing.

On the main deck below are situated the chain locker, the crew's toilet and wash rooms, the baggage room, the ladies' cabin finished in ash and red plush, the smoking room amidships, the social hall; on the starboard side aft is the refreshment room and bar and on the port side is the main dining room. At the extreme aft is an example cockpit, 25 ft. in length. The arrangements on this deck are clearly shown in Fig. 3. The idea of having the ladies' cabin forward on the main deck is original. The dining and refreshment rooms are finished in fir, mission style.

Good Accommodation For Crew.

Unusually complete accommodations for the crew are found on the hold deck. A detailed plan of this deck is shown in Fig. 3. The finish is all white enamel, pleasing to the eye, clean and sanitary. Forward of the boilers there is a forecastle for the crew and state rooms for the subordinate officers. Aft of the engine are rooms for the purser, steward, waiters and cooks. Here is also found the officers' mess, the crew's mess, the lower pantry, the galley and refrigerator. The galley occupies the full width of the boat and is unusually roomy. It is placed immediately below the pantry and bar on the main deck, communicating with the same by means of a dumb waiter.

On account of the fluctuation of the tides, provision is made for taking passengers on or off either on the hurricane deck, the promenade deck or the main deck. Wide, ample stairways connect these three decks. As is shown in Fig. 1, there are three companionways from the hurricane deck to the promenade deck, and also three from the promenade deck to the main deck.

Machinery of the Kennedy.

The main engines are of the four-cylinder, triple-expansion, high-speed type. They are previously described and illustrated in the MARINE REVIEW, Dec. 17, 1908. The cylinders are 17, 28, 34 and 34 in. in diameter by 24-in. stroke. At full speed, under 250 pounds pressure, the engines run at 205 revolutions per minute, driving a 9-ft., 6-in. diameter propeller with

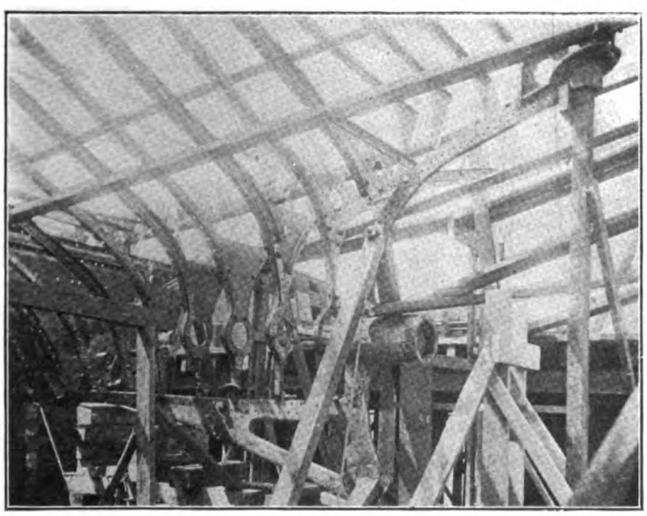

FIG. 6—STERN FRAMES, SKAG AND STERN BEARING OF STEAMER H. B. KENNEDY.

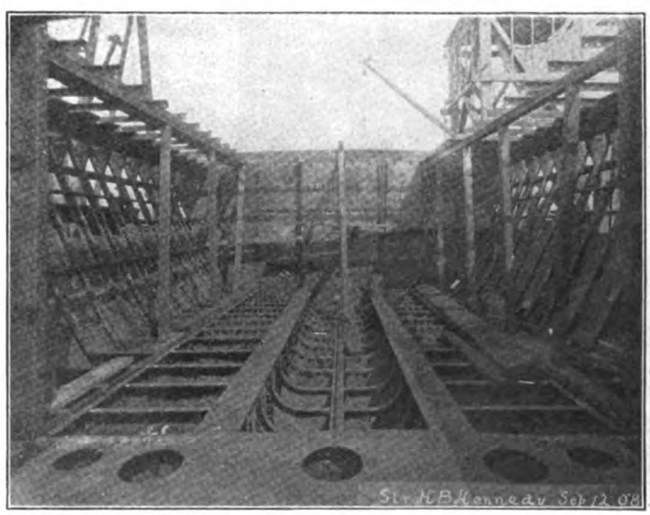

FIG. 9—DETAIL OF BOILER ROOM FRAMING OF STEAMER H. B. KENNEDY.

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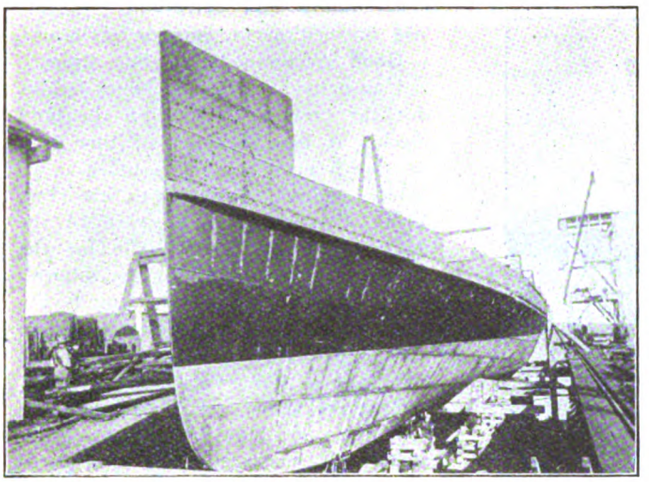

FIG. 7—HULL OF STEAMER H. B. KENNEDY READY FOR LAUNCHING.

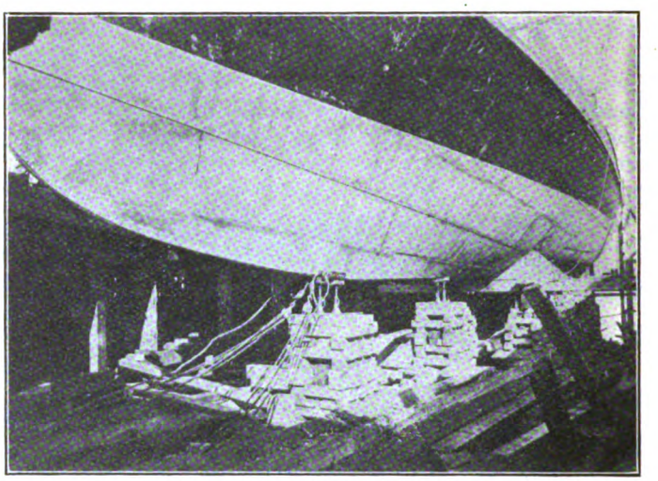

FIG. 8—DETAIL OF JACKS AND BLOCKING UNDER HULL WHEN LOWERING TO LAUNCHING WAYS.

10 ft., 3 in. pitch. The propeller is of the four-blade, high-speed type, specially designed for the boat. The shaft is of steel, solid, 8½ in. in diameter.

As was previously described Dec. 17, there are two patent Ballin water tube, sectional boilers, each with 4,000 sq. ft. of heating surface and individual funnels. The boilers are of vertical tubular construction with no pipes and are each tested to 500 pounds per sq. in. pressure, being designed to operate at 250 pounds. Natural draft is used. There are four "Best" oil burners for each boiler. Steam, which is used to atomize the crude oil, also increases the chimney draft. The oil tanks are located on each side of the boat between frames No. 38 and 53, or for a distance of 27 ft. fore and aft adjacent to the boilers. The tanks are isolated from the rest of the boat. They have a capacity of 500 barrels, 42 gallons per barrel.

The Kennedy's Auxiliary Machinery.

Both the main and auxiliary steam piping is direct and simple and has none of the necessary complications often found on small steamers. Auxiliary to the surface condenser are two independent Blake air pumps and a Morris Machine Co. circulating pump. Admiralty duplex fire and bilge pumps built by the Blake Steam Pump Co., are installed.

The auxiliary machinery includes a Williamson steam steering gear, Corey standard engine room telegraph and General Electric Co. dynamo. The dynamo is conveniently located on the starboard side, with the switchboard placed between it and the engine. The dynamo is 7-kilowatt, 118-volt, 575 revolutions per minute, direct connected to a simple, vertical steam engine.

Simplicity and positive action in the steering gear is obtained by locating the steering engine directly beneath the pilot house, the rods from the wheel leading straight to the steering engine through a vertical enclosed well.

The steamer has a capacity of 800 passengers and, as is seen from the foregoing description and the illustrations, is well adapted for the service for which she was designed. The drawings and photographs give but little idea of the beauty of the vessel. She is painted white outside with brass trimmings. The funnels are buff. The cabins are simple in design, excellent in finish, with enough of luxury to be pleasing to the eye and body and not so much as to be cloying.

With several hundred guests aboard the new steamer was given her builder's trial trip on the Columbia river Thursday afternoon, March 25. Leaving Portland at 1:45 p. m., she proceeded down the Willamette to the Columbia river and thence down the Columbia to St. Helens and return. The boat runs steadily with little wave disturbance. Except at the ex-

FIG. 10—RIVETING DECK PLATES ON STEAMER H. B. KENNEDY.

FIG. 11—RIVETING FIRST FRAMES OF STEAMER H. B. KENNEDY.

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treme aft, the vibration at high speeds is scarcely perceptible. On this trial, which will be followed by the official trial later, no attempt was made to maintain test conditions. The accompanying data gives a brief summary of the performance on the trial. This informal test indicates that the boat will experience no difficulty in fulfilling the specifications of her designer.

Data of Trial.

March 25, 1909, Willamette and Columbia rivers, Portland to St. Helens, Ore., and return. Distance one way, 27 miles:

Hull:—190 ft. over all, 25 ft. water line beam, 12 ft. 6 in. molded depth.

Draught (approximate):—9 ft. forward, 12 ft. aft.

Engine:—Four cylinder, triple-expansion, 17, 28, 34 and 34 in. diameter, 24-in. stroke, direct, vertical driven.

Boilers:—Two Ballin patent sectional water tube boilers, total water heating surface, 8,000 sq. ft. Pressure allowed, 250 pounds per sq. in. Crude oil burners, four for each boiler.

Oil tanks:—Capacity, 500 barrels, or 21,000 gallons.

Propeller:—9 ft. 6 in. diameter, 10 ft. 3 in. pitch, four blade, cast iron.

Boiler Pressure:—

Half speed	200 pounds
Full speed	220 pounds
Vacuum (average)	18 inches

Revolutions Per Minute:—

Half speed	112
Full speed	196
Total I. H. P. at full speed	1,900

Speed of ship in statute miles per hour:

Half speed	14.5
Full speed, down stream	21.5
Full speed, up stream	19.5
Full speed, reduced to a mean, taking account of current in river	20.73

Weather, fair.

Wind:—Northwest, brisk.

Fuel oil consumption:—Estimated at 18 miles per hour, 180.6 gal. per hour.

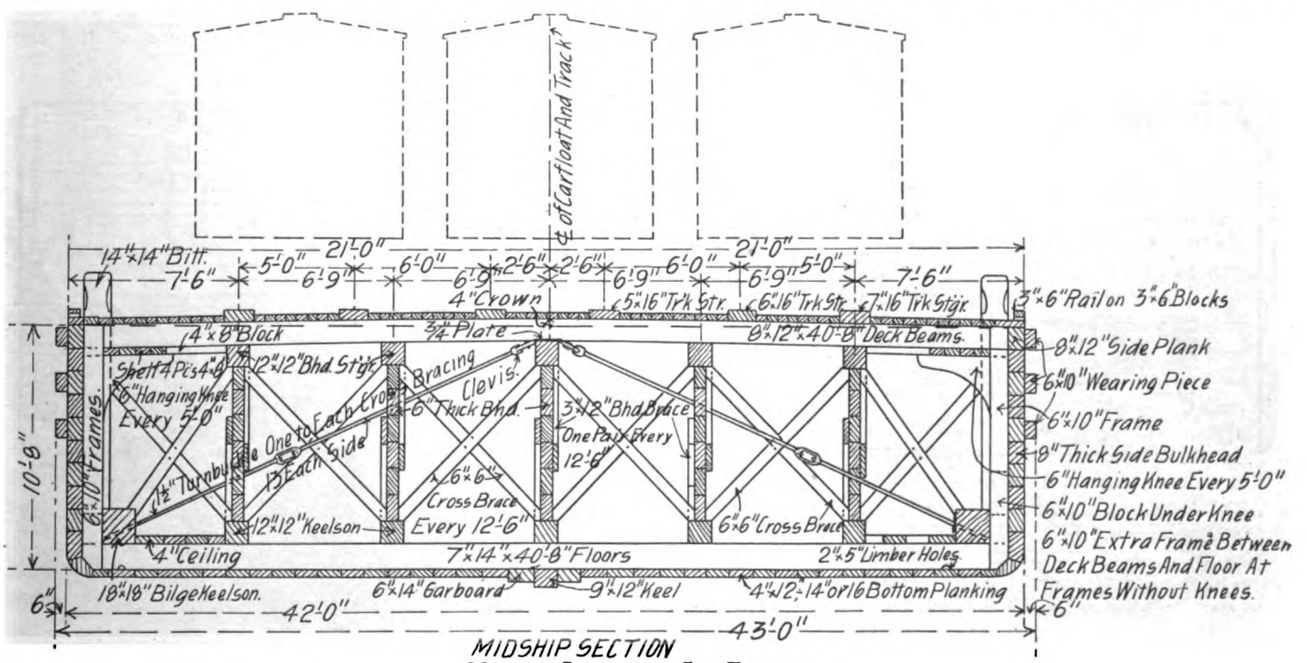
Wooden Car Ferries Built on the Pacific Coast.

AS ANNOUNCED in the MARINE REVIEW Feb. 18, the Milwaukee Terminal Railway, a subsidiary corporation of the Chicago, Milwaukee & St. Paul Ry., is having two exceptionally large wooden car ferries built by Hall Bros. Marine Railway & Ship Building Co., Winslow, Wash. These ferries, which we illustrate herewith with drawings and photographs, are among the largest of their kind on the Pacific coast. On the Atlantic barges of this size would undoubtedly be built of steel, but the low price of timber and the exceptional facilities offered by Pacific coast ship building yards for the construction of wooden vessels made it more economical to build these ferries of wood. The time required to do the work was also a factor in favor of wooden construction. The two barges are exactly alike and offer a good opportunity for the study of Pacific coast methods in the construction of craft of this character.

The ferries will be 191 feet long, with a breadth, outside of the wearing strips of 43 ft. The depth at the center of the barge from the deck beam to the bottom of the floors is 11 ft. There are three tracks running the full length of the deck. These tracks have a capacity of 12 standard freight cars. The wheel load of each car is assumed to be the maximum possible, 19,125 pounds, which gives the total dead weight load 1,836,000 pounds or roughly 1,000 tons.

Detail of Frames.

The frames, which are spaced 30 in., are built up as follows: Extending the full width of the bottom is a 7 x 14 in. floor timber, 40 ft., 8 in. long. To each end of this is bolted at right angles a 6 x 10 in. frame. Connecting the tops of the frames is an 8 x 12 in. deck beam, 40 ft., 8 in. in length. This bears the deck, which is made of 3 x 6 in. planking



MIDSHIP SECTION

MIDSHIP SECTION OF CAR FLOAT.

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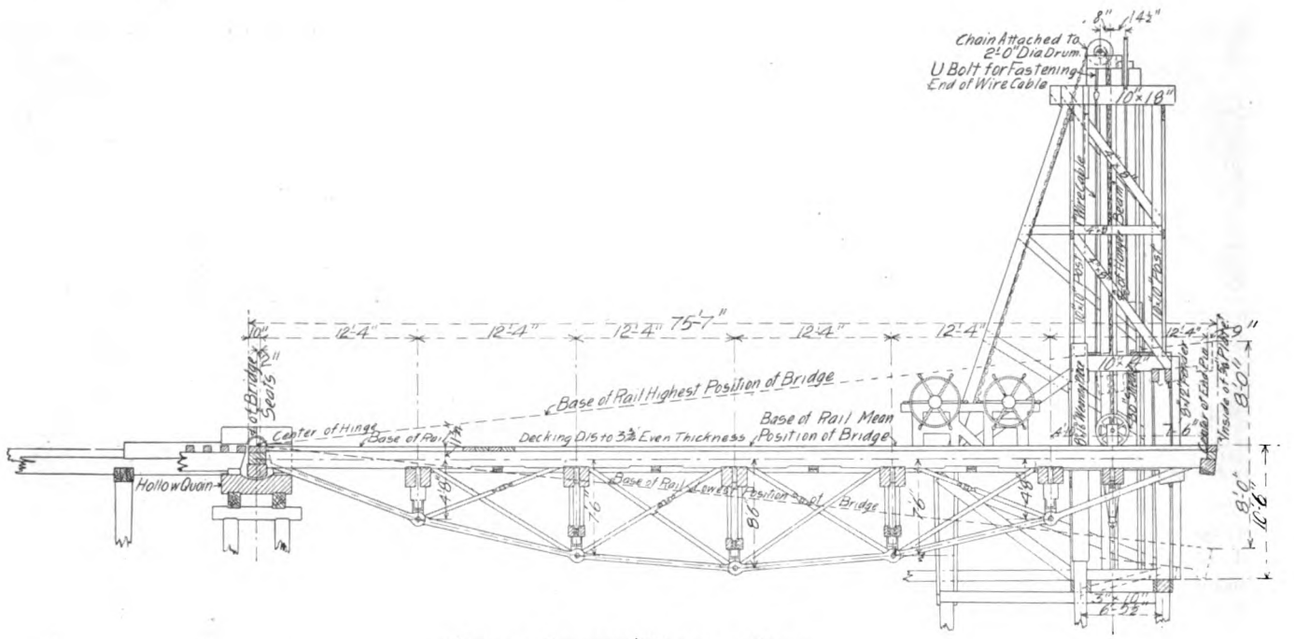
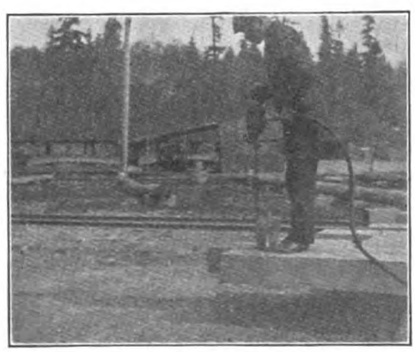

Chain Attached to 2'-0" Dia Drum
U Bolt for Fastening End of Wire Cable
Base of Rail Highest Position of Bridge
Base of Rail Mean Position of Bridge
Decking 0 to 3/8 Even Thickness
Center of Hinge
Base of Rail
Hollow Quoin
75'-7"

COUNTER BALANCED TRANSFER BRIDGE.

laid lengthwise, and the six, 6 x 16 in. track stringers spaced 5 ft. center to center between rails and 6 ft. center to center between tracks. Every 5 ft. for the full length of the barge, on each side, is a 6-in. hanging knee made of natural bent fir.

The bulkheads are longitudinal, five in number, 6 in. thick and watertight. The bulkheads will be built up of long 6 x 12 in. timbers and to insure watertightness and stiffness these timbers will be battened with 3 x 12 in. diagonal braces. As shown in the cross section published herewith the bulkheads are separated by 6 x 6 in. diagonal cross bracing,



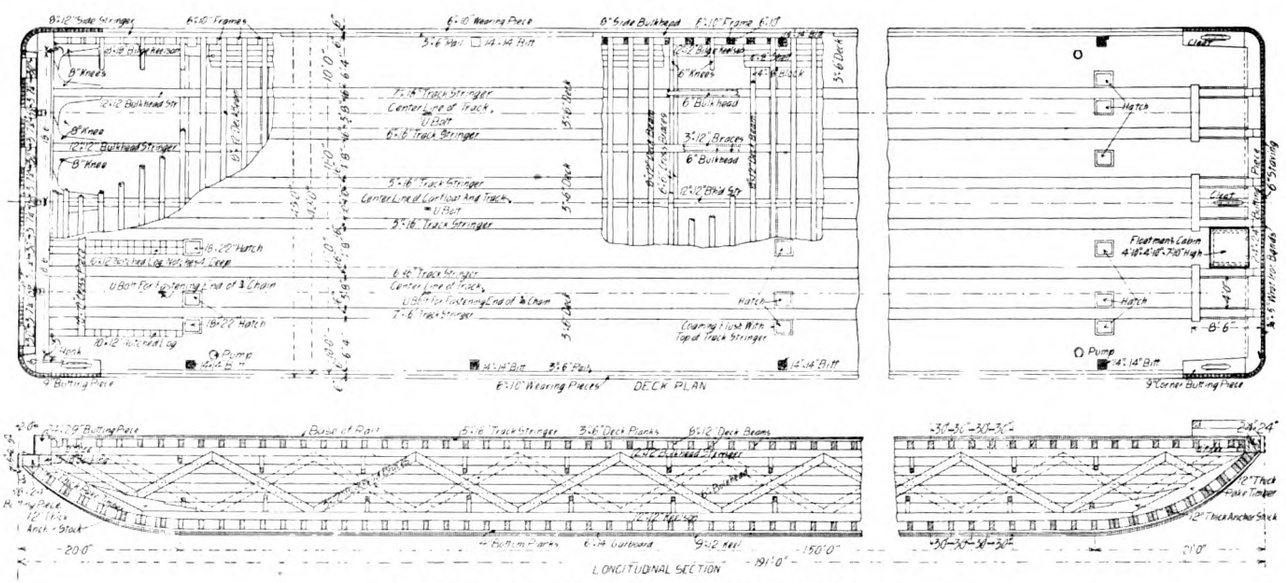
BORING BARGE TIMBERS WITH COMPRESSED AIR.

spaced 12 ft., 6 in. between centers. Thirteen diagonal tension rods, each 1½ in. in diameter with turnbuckles and bolts carry the stress from the lower corner of the cross section to the top of the central bulkhead.

The ceiling is 4 in. thick; the bottom planking is 4 in. thick and the side planking is 8 in. thick.

The barges will be built on temporary inclined ways built of 12 x 12 timbers, supported on 14 x 20 in. cribbing. The two barges are being built side by side and occupy a plot of ground in the ship yard 220 ft. in length by 125 ft. in width.

An interesting feature of the con-



LONGITUDINAL SECTION AND DECK PLAN OF CAR FLOAT.

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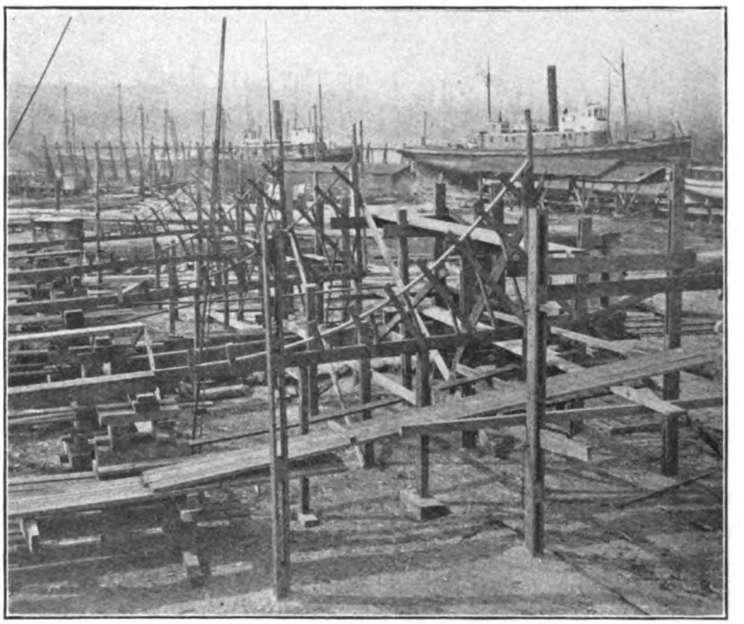
struction work, which has just begun, is the use of compressed air for boring, calking, driving spikes, etc. A system of pipes reaching every part of the yard on which the ferries are being built has been installed. These pipes carry air at 70 lbs. per sq. in. pressure. By means of hose connections portable tools can be used on any part of the barges. As an illustration of the efficiency of air tools in wooden ship building the writer noted that with an air driven auger eight seconds were required to bore through 6½ in. of well seasoned fir timber. The hole was ¾-in. in diameter and to bore it by hand would have required at least a minute. This eight seconds consumed in boring one hole was the time taken from the instant the auger was started until it had gone through the plank, been pulled out of the hole and set ready for the next hole. The actual time going through the timber was not over 4½ seconds. Air hammers are also very efficient in driving spikes in cramped quarters under the bottom of the barges, as they lie on the building ways.

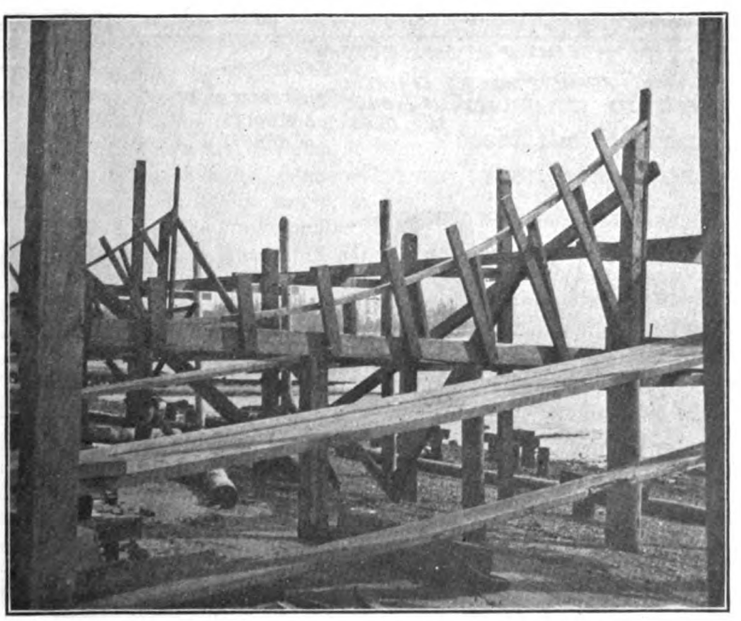
These car ferries will be handled entirely by tugs. They will be used to connect the main switch yards with certain mill spurs at Ballard and Old Tacoma, Wash.

To accommodate the rise and fall of the tide, which amounts to 12 ft., counterbalanced transfer bridges are being built. These consist essentially of a movable bridge hinged at the shore end and supported by cables which run over pulleys on piers at the outer end. The outer end of the bridge is counter weighted so that it is only 1,000 lbs. heavy and can be easily raised or lowered by one man at the windlass.

The ferries will cost approximately $20,000 each and will be ready for service June 15, 1909.



GENERAL LAYOUT OF THE MOLDS AND WAYS FOR THE CAR FERRIES.



MOLD FOR FRAMING THE BOW AND STERN OF THE CAR FERRIES.

The Sailing Schooner J. W. Clise.

THE THIRD distinctive type of vessel used in the Pacific coast lumber trade is the wooden sailing schooner. Very few steel schooners have been built but a large number of wooden vessels are in the service. As a type they are proven very efficient in the trade in which they are engaged. The standard lumber schooner on the Pacific coast is an 800-ton vessel of four masts, schooner rig, with a cargo capacity of 1,000,000 ft. board measure. We have selected for description, as a representative of this type of vessel, the schooner J. W. Clise, owned by the Globe Navigation Co., George F. Thorndyke, manager, Seattle. The Clise is a new vessel with all the latest improvements found on any Pacific coast sailing schooner. She is one of a fleet of three sister ships, the other two being the Wilbert L. Smith and the Alex T. Brown. The Smith is 170 ft. long, 40 ft. beam, 848 gross and 710 net tons register, built

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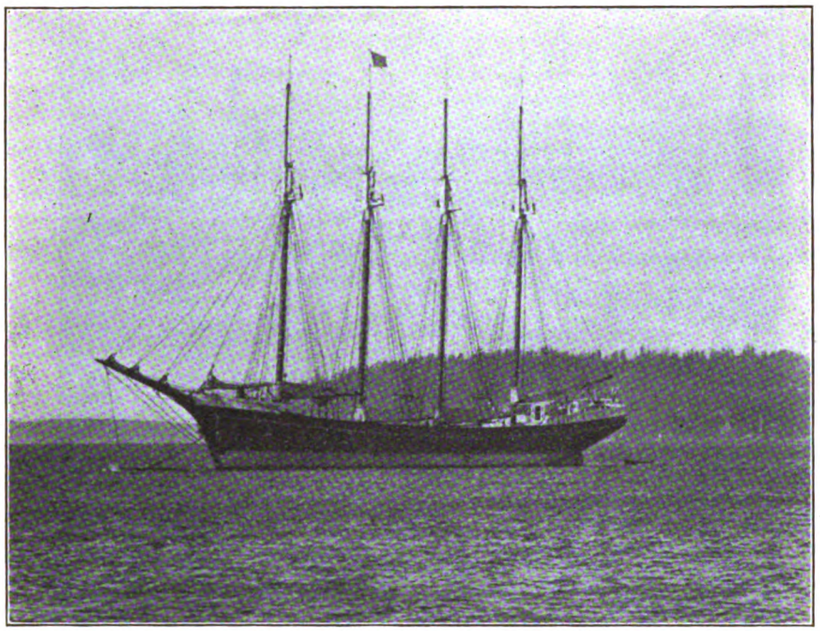


THE FOUR-MASTED SCHOONER J. W. CLISE.

in 1903. The Alex T. Brown is also 170 ft. by 40 ft. and is 788 gross and 654 net tons. She was built in 1904. All three vessels are four masters and were constructed at the Globe Navigation Co.'s yards at Ballard, Wash., under the supervision of T. C. Reed, master ship builder.

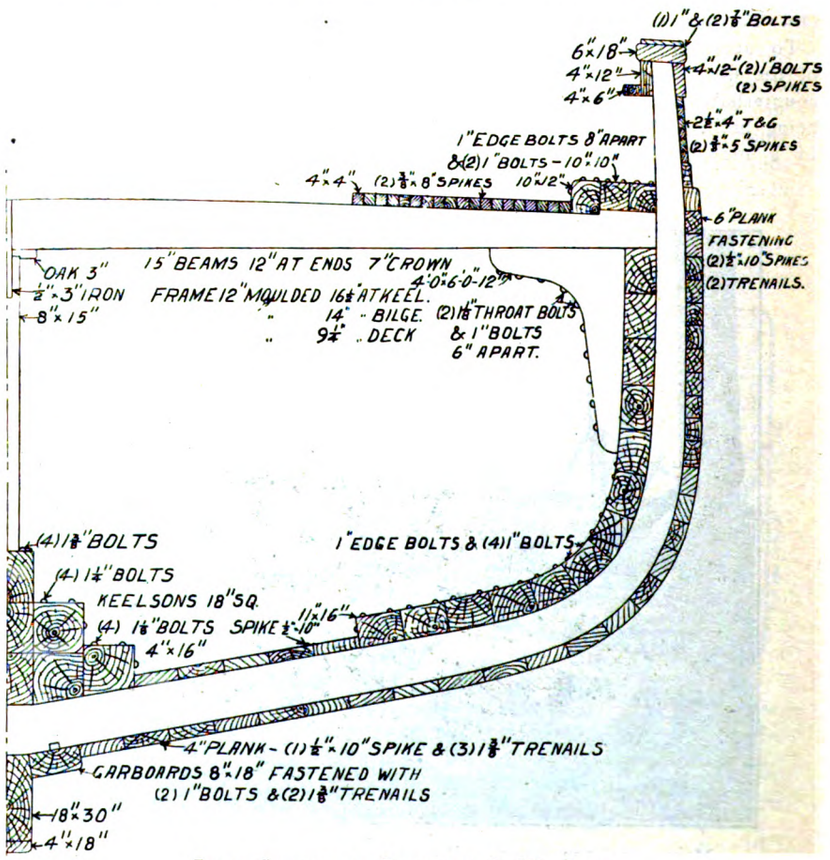
The schooner type of vessel, as far as large boats are concerned, originated on the Pacific coast and has now been generally adopted for coasting purposes the world over. The schooners have also been very successful in the deep sea trade. They are in fact the last step in the evolution of the sailing ship and it is in the form of schooners that the "wind jammers" will make their last stand against steam. The schooner can be operated with 50 per cent less crew than the square rigger, it maneuvers with great facility, its sails are more easily handled and it is exceptionally good in beating to windward.

The J. W. Clise was built in 1904 by the Globe Navigation Co., her present owner. She is 185 ft. length, 41 ft. beam and 15 ft. deep. Her registered gross tonnage is 845 and the net is 715. Her load water line draught is about 18 ft. As is shown in the accompanying cross section, the keel is 18 x 30 in., the ribs are 16 in. sq. at the keel, the garboards are 8 x 18 in., the planking is 4 in. net thickness, the flooring is 4 x 16 in. and the ceiling is 11 x 16 in. The keelsons are five in number, each 18 in. square fastened with through bolts ranging in diameter from 1⅜ in. to 1⅛ in. The deck beams are 15 in. sq. at the center and 12 in. at the ends. The main deck is 4 x 4 in. timbers well caulked. The knees are natural bent Washington fir. The material used throughout is Washington fir except for certain railings and bits of finishing. These dimensions and details indicate the sturdy construction of the vessel, which is specially designed to withstand severe storms encountered on the Pacific coast in winter.

The ship has no deck house forward, being built on what is called the extended fore-castle plan. This design leaves the main deck absolutely clear for cargo and adds to the strength of the ship, the walls of the deck houses being a part of the hull itself. Under the raised deck forward are the fore-castle, the galley and the chain lockers. Aft under the poop are the usual accommodations for the officers. The cabin fittings are fir, neat and inexpensive. The furnishings are comfortable, but not luxurious. Running water from a pressure tank located in the lazarette aft is provided. The ship is fitted with water closets and bath rooms.

There are four masts of equal length, named as follows: Fore-mast, main-mast, mizzen-mast and jigger-mast. Each mast, which is of straight, clear Washington fir, is built in two parts. The lower masts are each 110 ft. long and the topmasts are 80 ft.; the total height being 190 ft. She carries regularly a suit of 12 sails, each with the following approximate area:

	Square Feet.
Outer jib	738
Flying jib	632
Jib	730
Staysail	1,120



CROSS SECTION OF SCHOONER J. W. CLISE.

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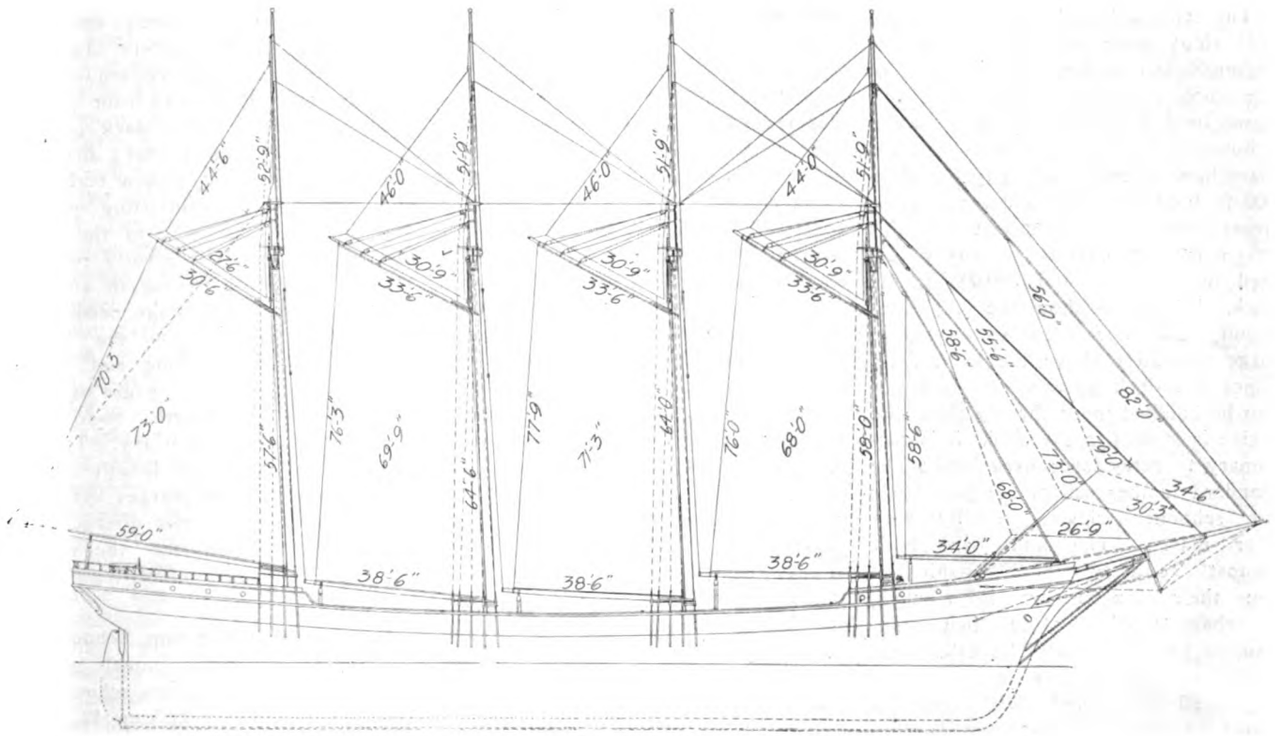

SAIL PLAN OF SCHOONER J. W. CLISE.

Foresail	2,540
Mainsail	2,540
Leg-o-mutton spanker	1,680
Ring tail topsail	600
Three triangular topsails, each 675 sq. ft.	2,025
Total approximate sail area	15,145

The distinctive feature of the rig is the leg-o'mutton spanker on the jigger mast, surmounted by a long triangular topsail called the ring tail topsail. This rig is much easier handled in tacking than the old boom and gaff style of sail.

The cargo hold is free of all obstructions from end of the vessel to the other. It has a capacity of 600,000 ft. board measure. A deck load of 400,000 ft is carried making the total capacity 1,000,000 ft. There are three hatches. The main hatch, which takes all the lumber up to 70 ft. in length, is 20 x 12 ft. in size, the two auxiliary hatches for shingles and small stuff are 16 x 9 and 8 x 9 ft. respectively. In addition there are stern and bow ports on the water line, each 28 x 33 in. in size. By means of these ports sticks as long as the ship can be loaded into the hold. For cargo hauling there are three Hyde steam friction-winches, each capable of lifting 3½ tons on the single gear. There is also a Hyde steam windlass for handling the anchor gear. These machines are operated by donkey boilers.

The J. W. Clise carries a crew of 11 men as follows: One captain, one first mate, one second mate, one cook, one cabin boy and six sailors.

The vessel cost $60,000. Year in and year out she will log 100 knots a day. Her sister ship, Wilbert L. Smith, once made the run from Kobe, Japan, to Cape Flattery, Washington, 4,800 knots, in 24 days or at the rate of 200 knots per day.

The three vessels mentioned in this article were all designed by L. H. Coolidge, naval architect, Seattle, Wash.

The Pacific Coast Lumber Carrying Fleet.

A Discussion of the Relative Advantages of the Sailing Vessel, the Wooden Steamer and the Steel Steamer for the Pacific Coastwise Lumber Cargo Business.

TWO previous articles in the MARINE REVIEW, including one in this issue, describe and illustrate in detail the three characteristic types of vessels engaged in the Pacific coast lumber carrying trade.[1] The fact that these three types are in service simultaneously indicates at once that the business is still in an evolutionary stage and has not yet reached the point where the vessel best suited for the work has clearly proven its superiority. In a few years, however, the vessels engaged in this trade between ports in the United States will be as thoroughly standardized as are the bulk ore carriers of the great lakes. A careful inquiry into the conditions surrounding the Pacific coastwise lumber traffic, a study of its three prominent types of vessels and a comparison of their relative merits are therefore peculiarly pertinent at this time and are of interest to the ship owner, the ship builder and the lumber exporter.

Before plunging into the discussion of the relative merits of the vessels themselves, it will make the situation clearer to review briefly the chief characteristics of the three types and to examine the features of the lumber export trade in general.

[1]See description of S. S. Riverside, Jan. 7, '09; S. S. Shna-Yak, Feb. 4, '09; sailing schooner J. W. Clise in present issue.

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The articles describing the three typical ships were published in reverse chronological order. The oldest of the three standard types of Pacific coast lumber carriers is the sailing schooner. Representative vessels of this class have a lumber capacity of 1,000,000 ft. board measure and a registered gross tonnage of about 850. Of this cargo about 650,000 ft. is usually carried in the hold and 350,000 ft. on deck. Lumber is about the only commodity that it is possible to carry in large quantities above the main deck. Since the deck portion of the cargo can be handled more cheaply than that which is stowed in the hold, it is customary to carry large deck loads. The standard lumber sailers are practically all schooner rigged, usually with four masts. The hulls are built almost entirely of Washington fir; their construction is staunch, a characteristic feature being unusually heavy ceiling. The cabins are neatly and comfortably furnished and are usually provided with running water and baths. The cargo is handled by steam winches, the steam being generated in donkey boilers. The hatches are as large as is consistent with the strength of the hull and most vessels are provided with stern and bow ports on the water line for loading extra long timbers. The cost of these schooners is from $60,000 to $75,000 each. Eleven men make up the average crew.

Development of the Steam Schooner.

The steam schooner came into existence in the early nineties as a result of the appearance of cheap coal on the Pacific coast markets. Since then then this type of vessel has grown steadily in favor. The typical wooden steam schooner is a vessel of 800 gross tons, solidly built with heavy ceiling and framing and with but little regard for refinements of form. The cabin accommodations are similar to those on the sailing schooners. Steam cargo and anchor winches are used and donkey boilers are, of course, unnecessary. The machinery is simple, durable and strong. The usual outfit comprises a single screw, a 600 horsepower triple expansion engine with surface condenser and a Scotch marine boiler carrying about 200 pounds per square inch steam pressure. Many of the more modern steamers burn crude oil. The machinery and cabins are all compactly located aft, leaving the cargo hold free of obstructions from end to end. The masts are usually two in number, provided with a few sails that are seldom used except in an emergency. The cost of a wooden steam schooner is from $125,000 to $140,000. The average crew consists of 20 men.

The steel steam schooner is only a logical development of the wooden steamer. The steel schooners are similar in design, rig and the arrangement of the machinery to their wooden counterparts. The average steel schooner is about 235 ft. in length, with a gross tonnage of 1,800. The cargo capacity is 1,500,000 board ft. The cost of a steel schooner varies from $175,000 to $200,000. Twenty-one men comprise an average crew.

Coastwise Lumber Trade.

The coastwise lumber trade of the Pacific exists because of the large demand for Washington and Oregon timber in California, Mexico and South America. In the five months between Sept. 1, 1908, and March 1, 1909, the reports of the Ship Owners' Association of the Pacific coast show 52 sailing schooners, 30 wooden steamers and five steel steamers engaged in this trade. The capacity of this fleet is approximately 90,000,000 board ft. of lumber; the total gross tonnage of the vessels is about 75,000. The lumber trade is badly depressed at present and this tonnage, now engaged, is below normal. The principal loading ports are Puget Sound, Grays harbor and Willapa bay, Washington, the Columbia river and Coos bay, Oregon, and Humboldt bay, California. The principal terminal ports are San Francisco, San Pedro and San Diego, California, Callao, Peru and Valparaiso, Chili. Present charter rates are $4.25 per thousand feet B. M. from Puget Sound to San Pedro. These rates are considerably below the costs per thousand feet of cargo shown by Tables I, II and III, and the only way ship owners are able to make both ends meet during such times is by shaving on maintenance charges, running with insufficient or no insurance and contenting themselves with much less than 6 per cent interest on their investment. The rates from Puget Sound to San Pedro under normal conditions vary from $6 to $6.50.

Statement of Earnings.

Table I, which is compiled from actual records, gives the annual expenses of a typical sailing schooner of 1,000,000 ft. capacity, making six round voyages annually between Puget Sound, Washington and San Pedro, California. The table indicates the expenses of the sailing schooner without the necessity of further explanation. A sailing schooner has one advantage peculiar to itself in that there is practically no limit to the length of voyage it may undertake. Therefore in depressed times, when some of the steam schooners have to lay up, the sailers can often find charters for long over-sea voyages and thus save themselves from being a dead loss during these slack periods. It is on the long voyages that the sailing vessels begin to show real economy, for then the proportion of towing, pilot charges, etc., to the other operating expenses is greatly reduced. The necessity for towing in and out of ports is a disadvantage peculiar to the sailing vessel. On the Pacific coast the tows are long and costly, and on short coasting voyages of up to 1,500 miles in length their proportionate expense is heavy. The income varies with the length of the voyage; the towing charges are fixed and independent of the distance and consequently the shorter the voyage the larger is the ratio of towing charges to income.

Expense of the Steam Schooner.

Table II gives the annual expense of a typical wooden steam schooner of 1,000,000 ft. capacity making 12 round voyages per year between Puget Sound and San Pedro. Table III gives the same information for a steel steamer of 1,500,000 ft. capacity. The peculiar advantage of the steamer over the sailing vessel lies in the greater speed of the former. A steamer equal in capacity to a given sailing vessel can carry twice as much lumber in a year and consequently bring in twice the revenue. Furthermore the steamer is independent of tugs and can therefore take and discharge part cargoes at several ports with economy, whereas the sailing schooner is economical only when running between two ports separated by a long distance. The advantage due to the steamer's independence of tugs is vividly illustrated by the present depression. Many steamers that would otherwise have had to lay up have kept running by loading a fraction of cargo at each of several ports until a full load was obtained, which load was distributed among several ports along the lower California coast. Under similar cargo conditions a sailing vessel would have been lying idle at anchor. But the steamer labors under the disadvantage of heavy standby charges when idle, which makes it sometimes almost if not quite as expensive to lay up as to keep running.

Ratio of Fixed Charges.

The tables show that the fixed charges of the sailing vessel, the wooden steamer and the steel steamer are to each other as 100:204:282. But the fixed charges per thousand board ft. of lumber carried per year vary as

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198:203:172, showing the superiority of the steel vessel of large capacity. The life of the hulls is assumed in all cases to be 20 years, giving an annual depreciation of 5 per cent. This is somewhat unfair to the steel vessels on account of their large salvage value when the end of their useful life is reached. The steel vessels, barring accidents, are also longer lived than the wooden ones but this is balanced by the larger expenditures required to keep the steel hulls in repair.

Dispatch in Loading and Unloading.

The steam schooners are loaded and unloaded much more rapidly than the sailing schooners. This dispatch is obtained because the construction of the steamers permits faster loading and chiefly because the standby charges of the steamer are so excessive as to demand all possible speed in loading. The custom of loading sailing vessels in a leisurely fashion has a strong influence and the dispatch accorded the two vessels is wholly disproportionate. Sailing vessels usually load or discharge 75,000 ft. per day while in the same time a steamer will load or discharge from 200,000 to 300,000 ft. On account of the rapidity with which a steamer is loaded a larger number of stevedores per thousand ft. of lumber handled is required and the labor is less efficient. For this reason the consensus of opinion is that the cost of loading a steamer is about 50 cents per thousand feet higher than the cost of loading a sailing vessel. The cost of loading a sailing schooner varies from 65 to 80 cents per thousand feet, B. M. The higher cost of loading a steamer is denied by some good authorities and one quotes 50 to 75 cents per thousand as the correct figures for these vessels, instead of $1.15 to $1.30, which is obtained by adding 50 cents to the cost of loading a sailing vessel. For this reason the 50 cents extra cost of loading the steam schooners has been added as a separate item in Tables II and III, so it may be readily deducted if desired. Such deductions would make no essential change in the relative economies shown by the tables.

Scale of Wages.

The wages paid on the sailing schooners, the wooden steamers and the steel steamers vary as 100:176:193. But again on account of the better dispatch obtained by the steamers and the additional capacity of the steel vessels the wages per thousand feet of lumber carried per year vary as 129:113:77.

The fuel costs of the wooden and steel steam schooners, per thousand feet annual capacity, are to each other as 92 is to 85.

The relative hold capacities of the three vessels are as 100:100:150, but the relative annual carrying capacities are as 100:200:325.

Advantages of Steel Vessel.

The construction of the steel vessel is such that it has a greater cargo capacity with the same dimensions. The steel steamer can also be built with much larger hatches than can the wooden steamer without impairing the strength of the hull. In case of accident, grounding on a bar, or collision, the wooden vessel is claimed to have the advantage. But this point is disputed by the advocates of the steel vessel. Owing to the growing ratio of bunker space to revenue producing cargo space, the economical sailing radius of a steam lumber schooner is limited to about 1,600 miles. Beyond this distance the sailing vessel is the more economical. The longest voyage made by the lumber vessels between ports in the United States is about 1,500 miles. Therefore for this traffic, which on account of foreign subsidized competition represents the large proportion of that enjoyed by American vessels, the vessel of the future is clearly the steel steam schooner. There are more of the other types in service at the present time because so many wooden vessels were built before the superiority of the steel ship was fully demonstrated and before the rising price of lumber made the first costs more nearly equal. But the steel steamer is the more economical in the long run and the same causes that brought about its success in other classes of service will bring its eventual triumph in the Pacific coastwise lumber traffic.

TABLE I.

Annual Expenses of a Typical, Four masted, Sailing Schooner of 1,000,000 feet B. M. Lumber Capacity Making Six Round Voyages Per Year Between Puget Sound and San Pedro, Cal. First Cost of Vessel, $70,000.

FIXED CHARGES:		
Depreciation, 5 per cent....	$ 3,500	
Insurance, 6 per cent.....	4,200	
Interest on Investment, 6 per cent	4,200	
Total Fixed Charges.....	$11,900	$11,900
OPERATING EXPENSES:		
Stevedoring, 6,000,000 ft. B. M. at $0.80 per M.....	$ 4,800	
Wages (Per Month):		
Master $125		
1st Mate 70		
2nd Mate 60		
Cook 60		
Boy 30		
6 Sailors 300		
$645x12=	7,740	
Food, 11 men, 40 cents per day, 360 days	1,584	
Towing, Pilot Charges, etc...	11,676	
Total Operat'g Expenses..	$25,800	25,800
Grand Total		$37,700
COST PER THOUSAND FT. B. M. OF CARGO.....	$6.29	

TABLE II.

Annual Expenses of a Typical Wooden Steam Schooner of 1,000,000 ft. B. M. Lumber Capacity Making Twelve Round Voyages per Year Between Puget Sound and San Pedro, Cal. First Cost of Vessel, $130,000.

FIXED CHARGES:		
Depreciation, 5 per cent on Hull, value $50,000	$ 2,500	
7 per cent on Machinery, value $80,000	5,600	
Insurance, 6½ per cent.....	8,450	
Interest on Investment, 6 per cent	7,800	
Total Fixed Charges.....	$24,350	$24,350
OPERATING EXPENSES:		
Stevedoring, 12,000,000 ft. at $0.80 per M.....	$ 9,600	
Wages (Per Month):		
Master $125		
1st Mate 75		
2nd Mate 60		
Watchman 50		
Chief Eng'r 125		
2 Asst. Eng'rs .. 140		
3 Firemen 150		
Cook 60		
Asst. Cook 40		
2 Boys 60		
5 Sailors 250		
$1135x12=	13,620	
Food, 20 men, 40 cents per day, 360 days	2,880	
Fuel: 12 trips of 14 days each,		
168 days running at 10 tons a day 1,680		
192 days in Port at 4 tons a day..... 768		
	2,448	
Say 2,450 tons at $4.50....	11,025	
Oil, Waste and Engineer's supplies	1,000	
Total Operating Expenses..	$38,125	38,125
Grand Total		$62,475
Add $0.50 per M for Additional Cost of Load'g Steam Schooner		6,000
Total Cost		$68,475
COST PER THOUSAND FT. B. M. OF CARGO.....	$5.70	

TABLE III.

Annual Expenses of a Typical Steel Steam Schooner of 1,500,000 Feet B. M. Lumber Capacity Making Thirteen Round Voyages per Year Between Puget Sound and San Pedro, Cal. First Cost of Vessel, $180,000.

FIXED CHARGES:		
Depreciation, 5 per cent on Hull, value $75,000	$ 3,750	
7 per cent on Machinery, value $105,000	7,350	
Insurance, 6½ per cent.....	11,700	
Interest on Investment, 6 per cent	10,800	
Total Fixed Charges.....	$33,600	$33,600
OPERATING EXPENSES:		
Stevedoring, 19,500,000 ft. at $0.80	$15,600	
Wages (Per Month):		
Master $130		
1st Mate 80		
2nd Mate 60		
Watchman 50		
Chief Eng'r 125		
2 Ass't Eng'rs .. 140		
3 Firemen 150		
Cook 60		
Ass't Cook 40		
2 Boys 60		
7 Sailors 350		
$1,245x12=	14,940	
Food, 21 men, 40 cents per day, 360 days	3,024	
Fuel: 13 trips of 14 days each:		
182 days running, 15 tons a day 2,730		
178 days in Port, 5 tons a day 890		
	3,620	
Say 3,700 tons at $4.50....	16,650	
Oil, Waste and Engineer's Supplies	2,000	
Total Operat'g Expenses..	$52,214	52,214
Grand Total		$85,814
Add $0.50 per M for Additional Cost of Load'g Steam Schooner		9,750
Total Cost		$95,564
COST PER THOUSAND FT. B. M. OF CARGO.....	$4.90	

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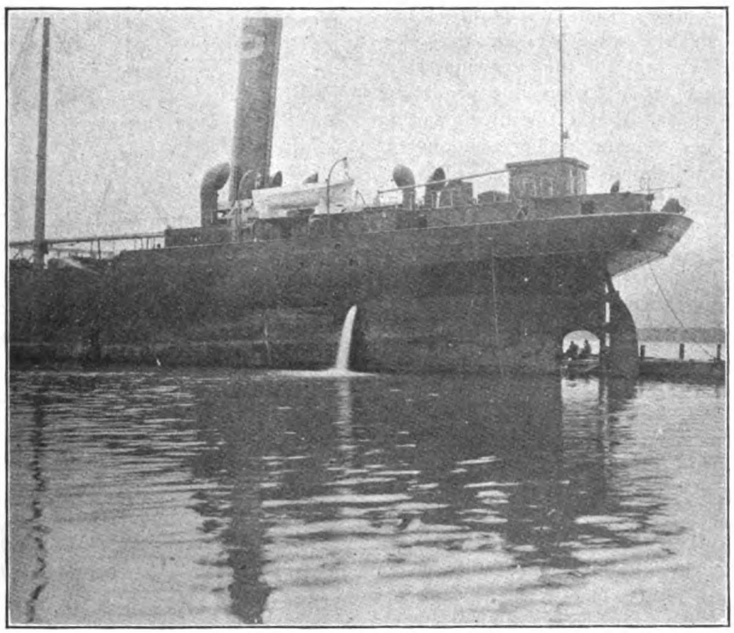
REPAIRING A PROPELLER WITHOUT RESORTING TO A DRY DOCK.

The feat of replacing a broken propeller blade of a 4,000-ton steamer without resorting to a dry dock was recently accomplished by the Gawley Foundry & Machine Works, Tacoma, Wash. The work was executed in as short a time as it could have been done in a dock, and at a cost actually less than that asked by other firms with dry docks at their disposal.



REPAIRING THE PROPELLER OF THE COL. E. L. DRAKE WITHOUT THE USE OF A DRY DOCK.

The repairs consisted in removing the broken blade, taking out the broken studs, refitting the new blade and new studs and trimming and straightening the other three blades of the propeller of the Standard Oil Co.'s tank steamer Col. E. L. Drake. The blade was broken in a terrific gale encountered by the Drake on her last trip from San Francisco to Puget Sound the week of Feb. 15. The repairs were made Feb. 22 and 23.

To make the repairs the steamer was towed up the city waterway at Tacoma to a point opposite the Wheeler and Osgood waterway, not far from the Gawley Co.'s plant. Here the vessel was securely moored. All possible weight aft was removed forward and enough water was pumped into the fore-peak and fore hold to weight down the bow and life the propeller half out of the water. When in this position a barge was brought along the starboard side and moored close to the propeller. Tackle was rigged; the damaged blade was removed and the new one set in its place.

The job occupied 25 working hours and except during the time the heavy blade was being handled, when five men were required, only two men, a machinist and a helper, were employed.

The repairs cost $1,000 and were executed under the direction of Mr. G. Wallace, marine superintendent of the Gawley Foundry & Machine Works.

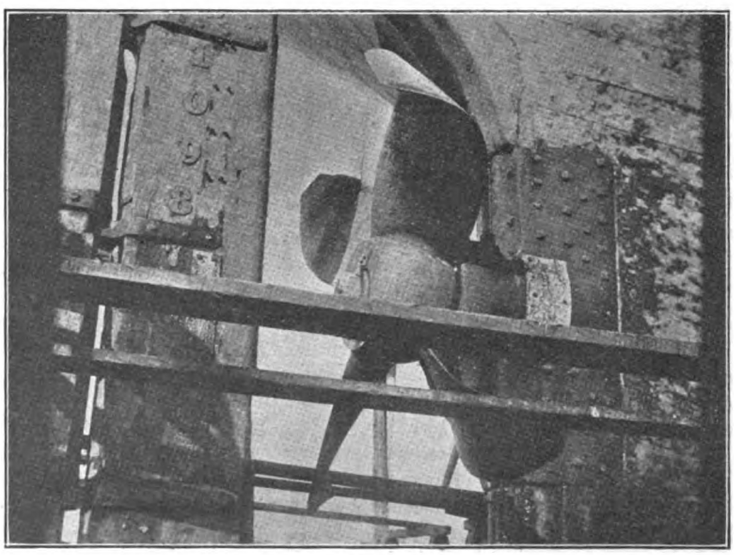
The Col. E. L. Drake is a steel tank steamer owned by the Standard Oil Co. Her registered tonnage is 4,205 gross and 3,307 net. She is 360 ft. in length and 50 ft. beam. Her engines are triple expansion 25, 41½ and 68 in. in diameter by 42 in. stroke. She was built in 1903.

A PROPELLER DAMAGED IN ARCTIC ICE.

We are privileged to reproduce herewith some interesting photographs of the damaged propeller of the United States revenue cutter Thetis.

The Thetis cruises annually in the Arctic ocean along the northern Alaska coast, leaving Seattle in April or May and returning in November. In July, 1908, the cutter encountered unusually heavy ice in the north, in contact with which the propeller was damaged. One blade was bent backward 180 degrees, the other forward about the same amount and the end of the third was broken off. The peculiar feature of the whole matter is that with the propeller damaged in this manner the Thetis steamed 4,000 miles at no apparent decrease in speed or decrease in the efficiency of the propeller. The only change noted after the accident was a slight increase in the revolutions of the engine; the speed before the damage was 70 R. P. M. and afterward it was from 72 to 75 R. P. M.

The damaged wheel is bronze, 12 ft. in diameter, 14 ft., 6 in. pitch, with a helicoidal area of 37 sq. ft. The composition of the wheel is as follows: Copper 88 per cent, tin, 10 per cent, zinc, 2 per cent. As the photographs testify, this bronze is very tough and ductile and is a mixture that can be recommended for wheels that are subjected to hard usage.



PROPELLER OF REVENUE CUTTER THETIS DAMAGED IN ARCTIC SEA.

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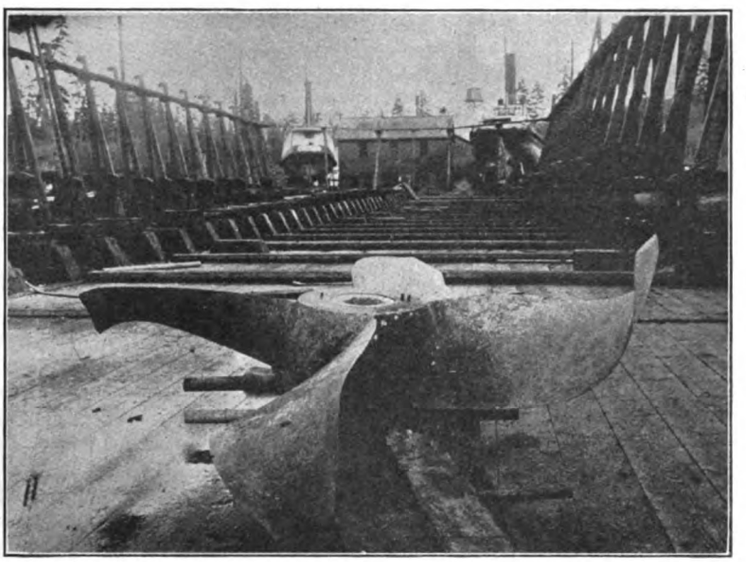


DAMAGED PROPELLER OF REVENUE CUTTER THETIS AFTER REMOVAL FROM SHAFT.

Sea Going Suction Dredges*

By Thomas M. Cornbrooks, Esq.

DURING the past five years, the engineer's department, United States army, have contracted for a number of sea-going suction dredges. These have been of varying sizes, ranging from 166 ft. to 300 ft. long, the capacities of bins ranging from 1,000 to 3,000 cu. yds. As the design of all these dredges has been similar, the description of one will apply to all. The latest dredge is the Galveston, just completed at the works of Maryland Steel Co., Sparrow's Point, Maryland.

*Paper read at annual meeting Society of Naval Architects and Marine Engineers.

As will be seen by the plates, the dredged material is carried in two large bins, one forward and one aft of the machinery space.

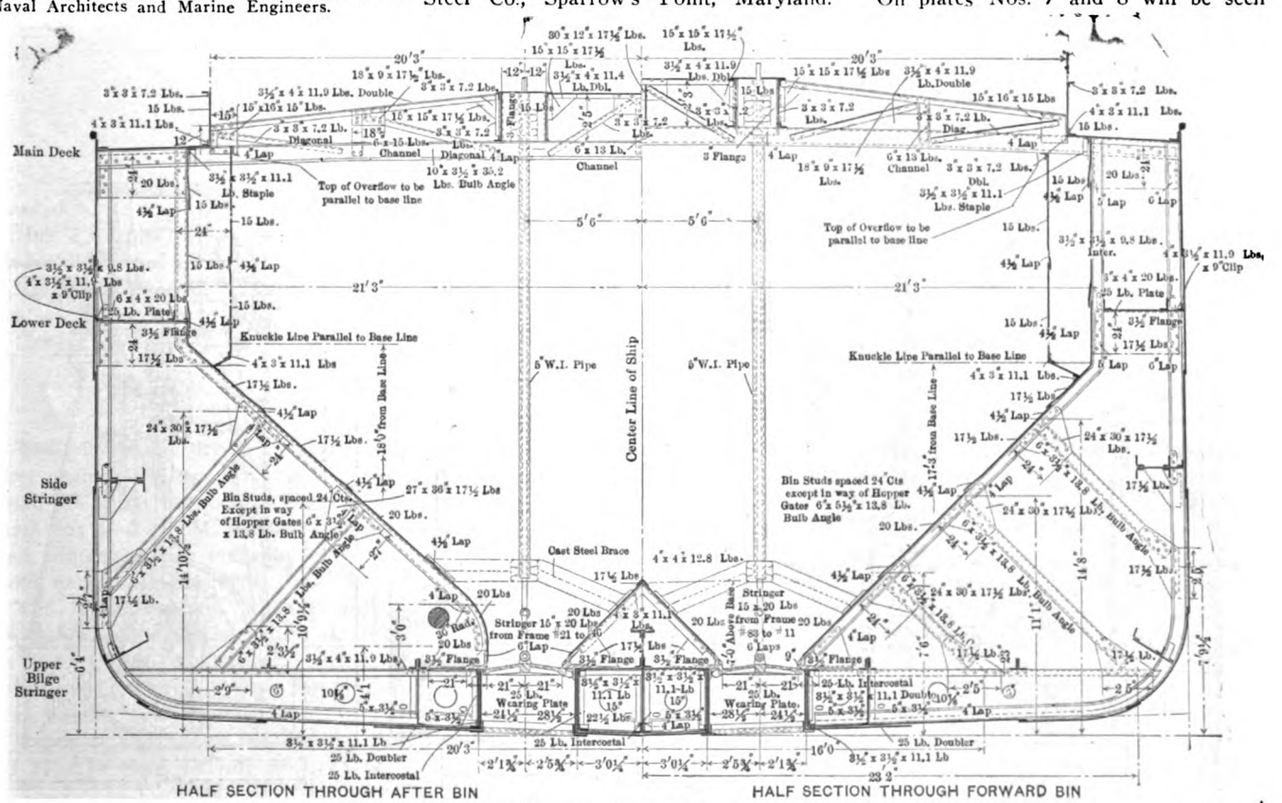
In operation, the dredge is kept moving forward, at a speed of about six knots per hour, with the suction pipes dragging on the bottom. The material is sucked up by 20-in. centrifugal pumps and discharged into bins, through pipes and distributing chutes on top of bins. By means of gates in bottom and sides of these chutes it is possible to distribute the material evenly. As the bin fills the water is drained off by overflows through the sides. When the bins are filled the dredge proceeds to the dumping grounds and, opening the gates in bottom, drops the material. The gates are operated by means of a double-cylinder vertical engine through worms and fixed nut on vertical rods.

The officers and crew have commodious quarters in houses on deck and on lower deck forward and aft as shown on plates.

The propelling machinery consists of two compound engines, steam for which is furnished by four single ended boilers.

In trying these dredges, we have discovered that a very large rudder is necessary. This we ascribe to the shafts being so far outboard and the extreme fullness of after body.

On plates Nos. 7 and 8 will be seen


Main Deck
Lower Deck
Side Stringer
Upper Bilge Stringer
Center Line of Ship
Knuckle Line Parallel to Base Line
Top of Overflow to be parallel to base line
Bin Studs spaced 24" Cts except in way of Hopper Gates 6"x 3½"x 13.8 Lb. Bulb Angle
Cast Steel Brace
Wearing Plate
25 Lb. Doubler
25 Lb. Intercostal
HALF SECTION THROUGH AFTER BIN
HALF SECTION THROUGH FORWARD BIN

SECTION THROUGH BINS OF UNITED STATES DREDGE GALVESTON.

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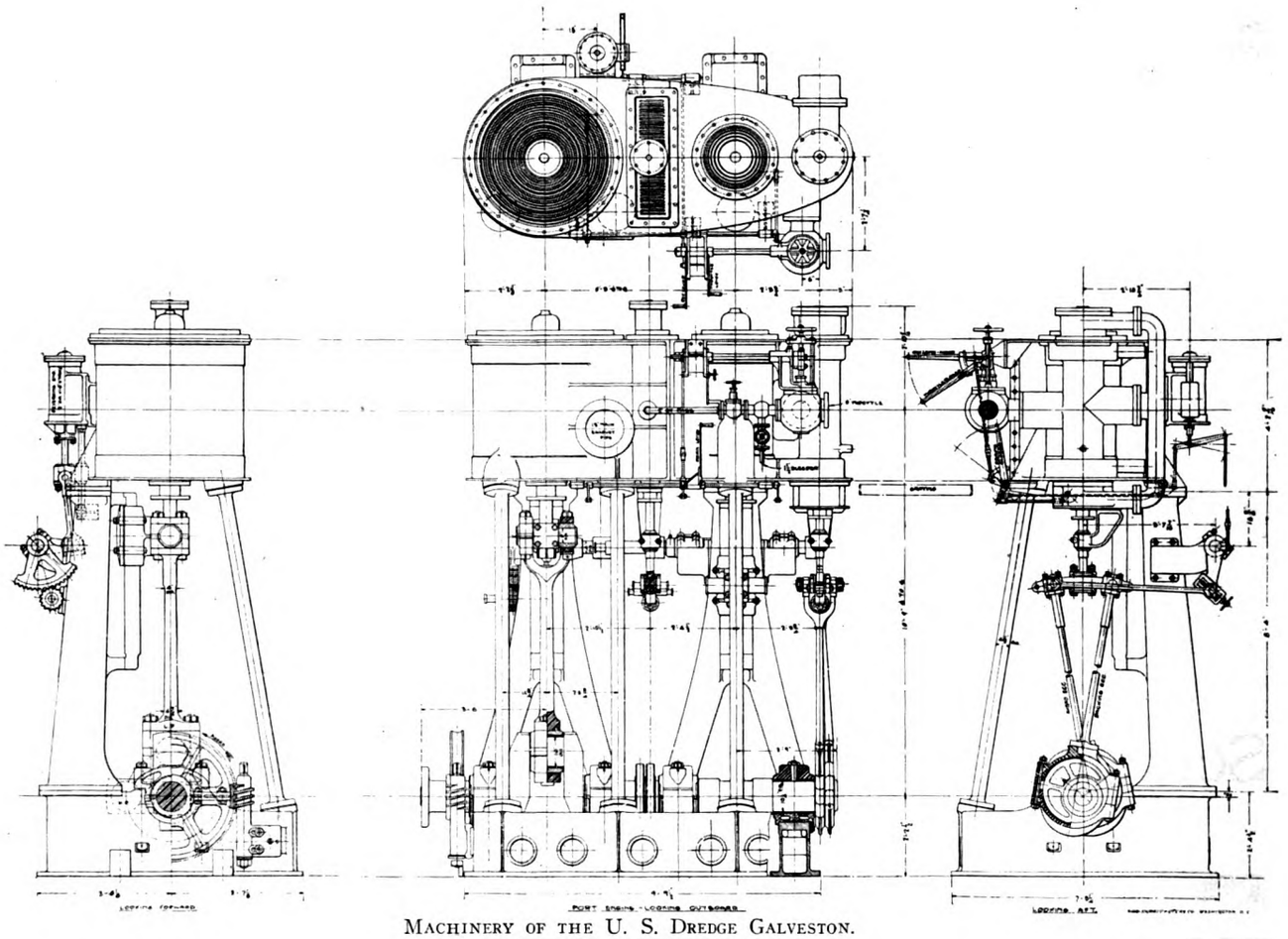
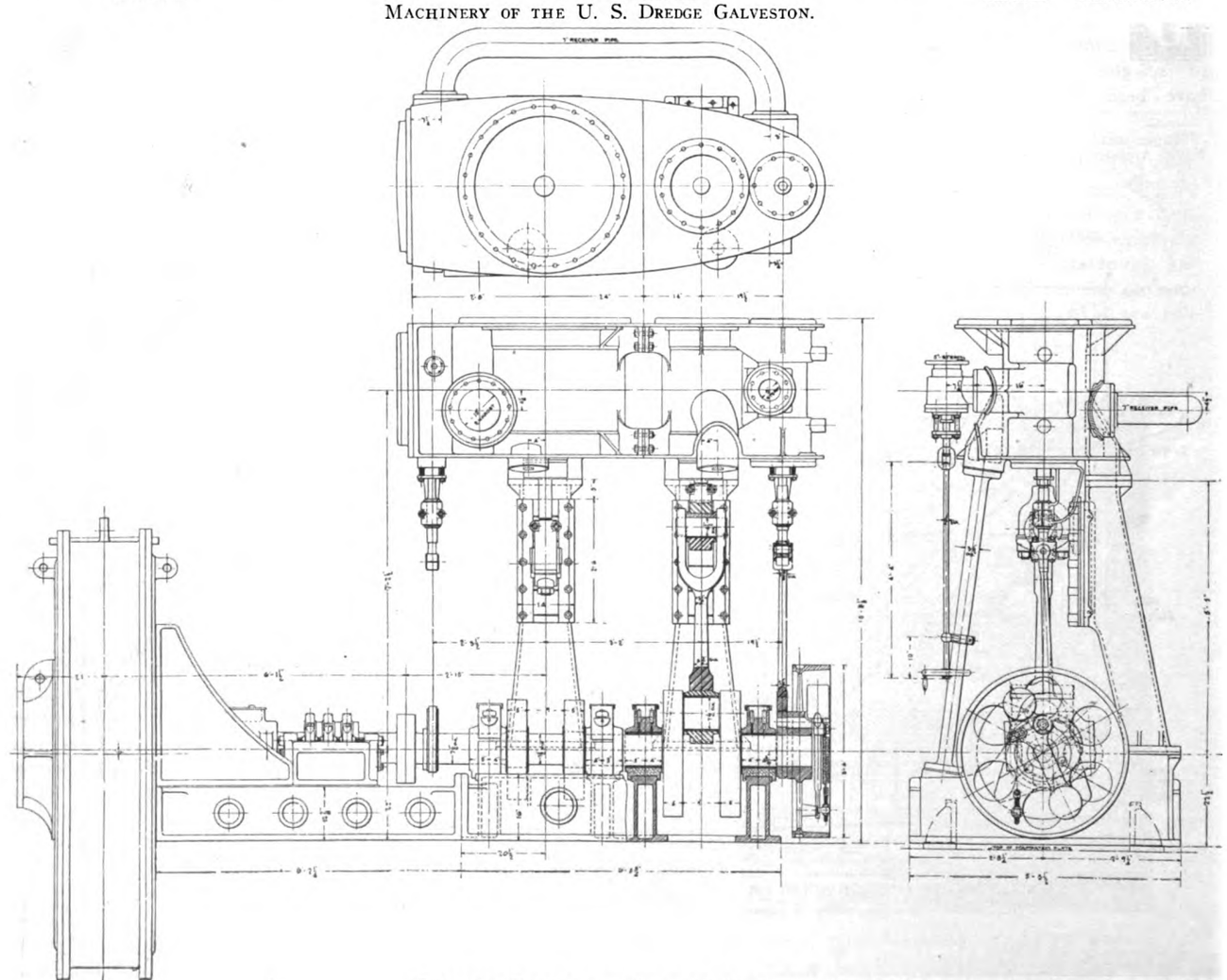


MACHINERY OF THE U. S. DREDGE GALVESTON.



PUMPING ENGINE AND PUMP U. S. DREDGE GALVESTON.

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the curves of bending moments, etc., and equivalent girder, for the latest New York harbor dredges Raritan and Navesink. It will be noticed that the neutral axis of girder is very low, showing that the material is not distributed to the best advantage.

The bending moment for hogging works out $\frac{L \times D}{47.34}$ and the stresses:

Tension in sheer strake, 4.22 tons.
Compression in keel, 2.73 tons.

On the two dredges Ancon and Culebra, built for the Isthmian canal commission, we located sights and measured the deflection under load. On loading for the first time, a deflection of 5-16 in. in 200 ft. was recorded. This returned to within 1-16 in. of original marks when the load was dumped, which would indicate that the structure is amply stiff.

On these dredges we also conducted inclining experiment, memoranda of which is given below:

Draught forward, 10 ft. 4 in.
Draught aft, 11 ft. 9 in.
Displacement, 2,375 tons.

Conditions:

Bilges, dry.
Water tanks, full.
Boilers, full.
Workmen on board, 30.
Bunkers, half full.
Hopper gates, open.
G. M., 7,187, as inclined.
Trans. B. M. = 20.4 ft.
Trans. C. B. = 5.53 ft.

25.93
7.19

18.74 = C. G. above [base.

Loaded:

Hull 2,375 tons.
Load 3,085 tons (at 128 lbs. per cu. ft.)
Corrected C. of G., 18.14 ft.
Met. above base = 20.8
C. G. above base = 18.14

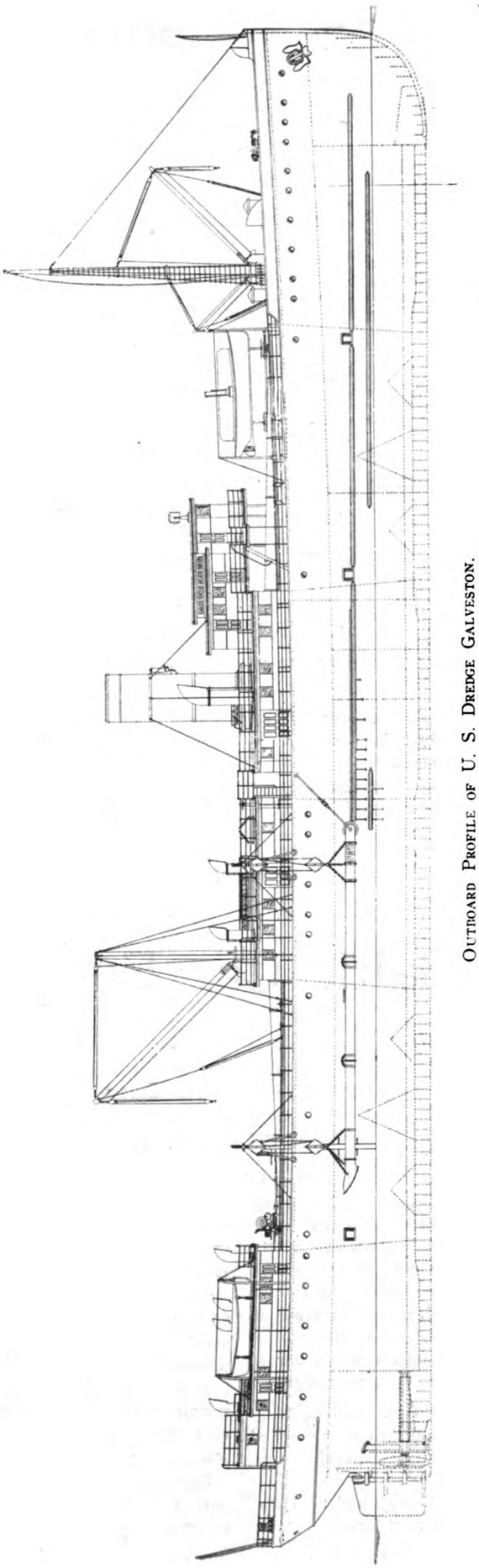
2.66 = G. M. [loaded.

The percentage dredged depends on the quality of material, and ranges from 10 to 60 per cent. The dredges start out at 5 A. M. Monday, summer and winter, and do not return to dock until noon on Saturday.

The Manhattan and Atlantic worked 24 hours per day from June 1, 1907, to Feb. 1, 1908, and only averaged 40 hours per month lost time for repairs, bad weather and coaling.

Below is the record of Raritan for 10 days previous to July 31:

Number of loads, 44.



OUTBOARD PROFILE OF U. S. DREDGE GALVESTON.

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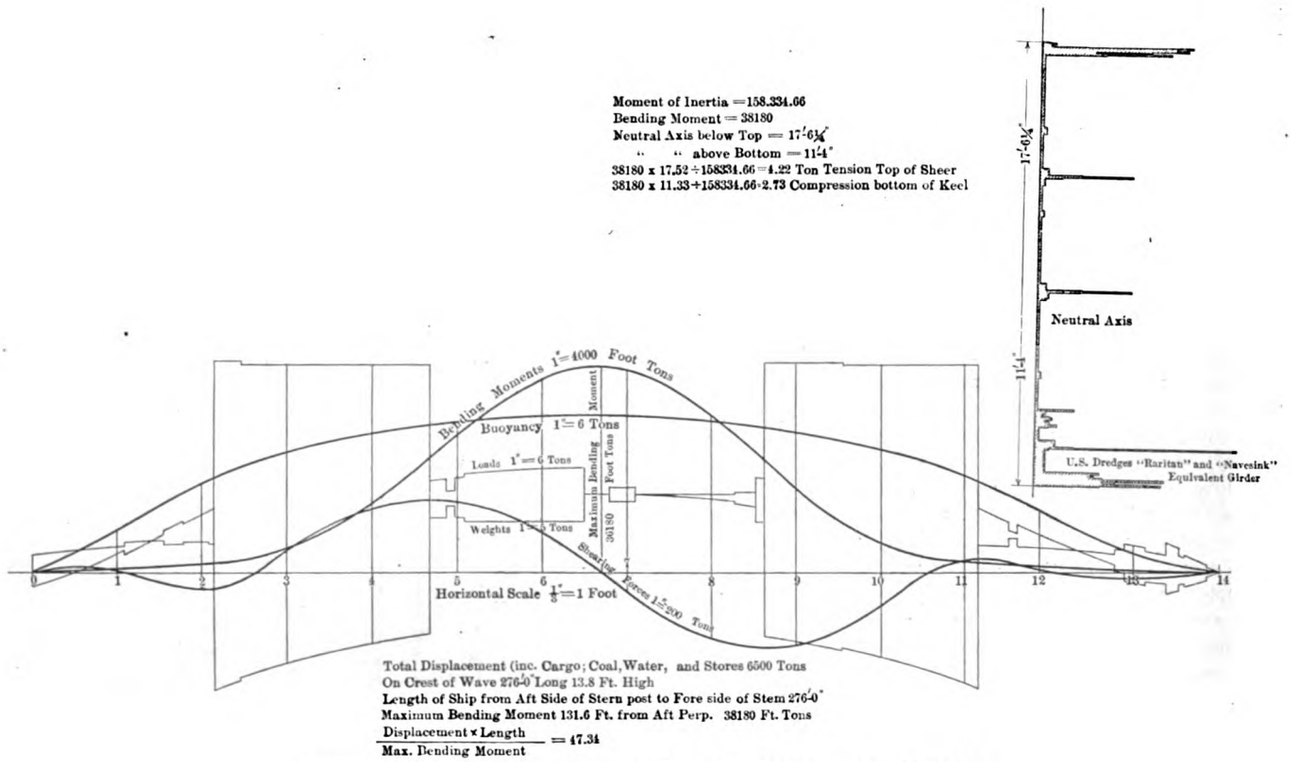
Moment of Inertia = 158.334.66
Bending Moment = 38180
Neutral Axis below Top = 17'-6¼"
" " above Bottom = 11'-4"
38180 x 17.52 ÷ 158334.66 = 4.22 Ton Tension Top of Sheer
38180 x 11.33 + 158334.66 = 2.73 Compression bottom of Keel
Neutral Axis
Bending Moments 1" = 4000 Foot Tons
Buoyancy 1" = 6 Tons
Loads 1" = 6 Tons
Weights 1" = 6 Tons
Maximum Bending Moment 38180 Foot Tons
Shearing Forces 1" = 200 Tons
Horizontal Scale ⅛" = 1 Foot
U.S. Dredges "Raritan" and "Navesink"
Equivalent Girder
Total Displacement (inc. Cargo; Coal, Water, and Stores 6500 Tons
On Crest of Wave 276-0" Long 13.8 Ft. High
Length of Ship from Aft Side of Stern post to Fore side of Stem 276-0"
Maximum Bending Moment 131.6 Ft. from Aft Perp. 38180 Ft. Tons
Displacement × Length / Max. Bending Moment = 47.34

CURVES OF BENDING MOMENTS OF DREDGES RARITAN AND NAVESINK.

Cubic yards material pumped, 117,666.
Pumping time, 7,465 minutes.
Turning, 415 minutes.
Running to dump, 2,225 minutes.
Dumping, 490 minutes.
Returning to grounds, 1,685 minutes.
Pumped per minute average, 15.8 cu. yds.
Time at dock, 23 hours.
Minor repairs, 12 hours, 20 minutes.

Baltic Car Ferry.

A SOMEWHAT uncommon type of steamer was launched from the Neptune Works of Swan, Hunter & Wigham Richardson, Ltd., on Feb. 22. The steamer is intended to carry railway trains across the Baltic and is remarkable for the length of voyage she will accomplish. Usually when trains are carried across arms of the sea the transit is but short, in this case however the voyage will take place from Sassnitz in Germany to Trelleborg in Sweden, a distance of no less than 65 nautical miles, across sea which at times is very rough.

The vessel is 354 ft. in length by over 50 ft. beam and will be propelled by twin-screw, triple-expansion engines supplied with steam from four large boilers working under Howden's system of forced draft.

The trains are carried on two tracks on the car deck, occupying nearly the whole surface of the deck. Above that are very luxurious rooms for the passengers including smoking room, lounge, special suites, etc. Underneath the car deck are a large number of staterooms for passengers who are not occupying the sleeping berths on the train, both first class and third class are provided for.

The vessel has been designed to be very steady at sea and has unusually large bildge keels fitted to minimize the rolling. A large number of ring plates and screws and spring buffers are arranged to prevent the cars from moving when at sea.

For safety in entering and leaving port a bow rudder is fitted as well as the stern rudder and both are controlled by steam from the captain's bridge.

The steamer has been divided into a very large number of watertight compartments which, with the Stone-Lloyd bulkhead doors with which she is fitted, render her practically unsinkable. She is also to be fitted with a submarine signal installation.

The ventilating and heating is ensured by an installation of thermo tanks enabling fresh warm air to be forced into all the rooms in winter and fresh cool air in summer.

It is intended that the vessel shall have a speed of over 16 knots per hour which will enable her to make her journey between Trelleborg and Sassnitz within 4 hours.

The vessel is being built to the order of the Royal Administration of the Swedish State Railways who were represented at the launch by Mr. Klemming, their assistant director general. Mr. W. Hok, naval architect, of Stockholm, under whose superintendence the vessel has been built and who is responsible for the design, was also present, as well as Capt. Ljungberg, who will take command of the vessel when she is completed.

The christening ceremony was gracefully performed by Mrs. J. Denham Christie, of Tynemouth, and the vessel was named the Drottning Victoria.

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Safety Valves for Marine Boilers.

The recent experiments carried out at Barberton, O., for the purpose of determining the actual lifts and discharge capacities of standard spring-loaded safety valves, and forming the subject of a paper presented at the February meeting of the American Society of Mechanical Engineers, are likely to result in radical modifications of the existing rules. The rule of 1904, still in force, determines the diametral area of safety valves by dividing the weight in pounds of water evaporated per hour by the absolute pressure in pounds and multiplying the quotient by the constant .2074.

The derivation of this constant is not material to this discussion, but it is based on Napier's well known formula for the flow of steam; the difficulty lies in the fact that the experiments demonstrated conclusively that scarcely any of the standard makes of valve satisfy the conditions as to lift. The rule assumes, arbitrarily, a lift of one thirty-second of the nominal diameter, so that a 4-inch valve for instance is assumed to lift ⅛ in. Only one of the seven standard makes tested satisfied this condition, the others ranging down to about one-fourth of that, yet under the rule all have the same rating as to relieving capacity.

The tests demonstrated further that the average lifts were fairly alike for all diameters and less than half that assumed by the rule, and the capacity tests showed that the rate of flow on which the rule is based is practically correct. For comparison let us assume a Scotch type boiler with two 44-in. furnaces and 5 ft. 3 in. bars, equal to 38 sq. ft. grate area, and working under mechanical draft. A very ordinary rate of combustion under such conditions is 30 lbs. per sq. ft. of grate per hour, and with an evaporation rate of say 10 lbs. the total evaporation is 11,400 lbs. per hour. For comparison with one of the valves under test we will assume that the working pressure is the same, 135 lbs., or 150 lbs. absolute.

We have then $\frac{38 \times 30 \times 10 \times .2074}{150} =$ 15.76 sq. in. area for valve, or say 4½-in. diameter. The lift of this valve the rule assumes to be 9-64 in. Corrected for comparison with a 4-in. valve under test which actually discharged 11,020 lbs. per hour with just under 3-16 in. lift, at the same absolute pressure, and it is seen that if the assumed lifts actually obtained the rule would be extremely satisfactory.

The rule however is defective in other ways. It leaves the dominant factor, the evaporation, wide open, and the inspectors are in no position to determine its value in the equation. The rate of combustion and consequent evaporation is entirely too flexible for use as a determining factor; it may easily be largely increased beyond the rate assumed in the calculation and entirely outside of the knowledge or even the control of the inspectors. The substitute rule proposed as a result of these experiments, while still retaining the evaporation as the dominant factor, takes account of the lifts as actually found, and, for the case illustrated, would give a valve 8 in. diameter, or, since circumferential area is the end sought, two 4 in. valves. This is based on an actual average lift of 3-32 in. and the usual 45 degree seats.

An interesting point brought out in the discussion has reference to the fact that in naval work the area of escape pipes from safety valves is usually not over half the nominal area of the valve or valves, whereas United States inspectors of steam vessels have always insisted that it be at least equal, although the rules are silent on the subject.

It is also instructive to consider that whereas in the case assumed for illustration, if the working pressure had been 175 lbs. the valve would, under the rule, be 4 in. diameter, but if for any reason the steam pressure was cut down to say 125 lbs. and the rate of evaporation maintained as before, the valve would have to be increased about 50 per cent. So that while severe penalties are provided for carrying an excess of pressure there is nothing to prevent a reduction, which under some circumstances might be equally dangerous.

HYDROSTATICS OF SHIP BUILDING.

Mr. W. Boyd recently brought before the members of the Liverpool Engineering Society "a few of the problems and difficulties with which shipbuilders have to contend in the earlier stages of their efforts to construct for the very exacting and critical shipowners of the present day, a ship which will meet with all their manifold requirements and will prove worthy of the best traditions of the building yard." The various problems relating to the design of vessels of the present day were considered by the author in outline as follows:

Suppose a shipowner requires a vessel of 7,000 tons deadweight and to carry the same on a draught of 23 ft. mean in salt water. Speed at sea to be 12 knots per hour loaded; other particulars may be supplied as to the type of vessel required, whether it is to be classed at Lloyd's or British Corporation; shelter deck type, or to have poop, bridge and forecastle decks; the number of steel decks and if sheathed with wood, as well as particulars of any passenger accommodation and special fittings, etc. The builder first of all makes an estimate of the dimensions, weight of hull and machinery, displacement at the specified load draught and block co-efficient, and then proceeds to estimate the horsepower to drive the vessel at the specified speed.

The general practice is to base this latter approximation upon the actual performances of preceding ships, making use of recorded co-efficients of performance. The block co-efficient of fineness should be such that it will give the most economic results for speed taken in conjunction with the dimensions and draught of water, it being obvious that a fast vessel requires a finer co-efficient than a slow vessel. For the above ship, suppose the required dimensions to be 400 ft. by 50 ft. and the block co-efficient 0.74 and the loaded displacement 9,700 tons, made up of 7,000 tons of cargo, coal and stores, the remainder being the weight of hull and machinery.

Other Problems to be Solved.

The lines of the vessel are then designed to give this displacement at 23 ft. draught on the dimensions fixed upon. In deadweight carriers, the lines cannot vary very much with different builders, as the midship area is usually a maximum and extends for fully half the length of the vessel, so as to obtain the finest entrance and run possible; but in the case of fast passenger vessels great care must be taken to obtain the best under-water form of least resistance and at the same time satisfy conditions of trim and stability.

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THE PANAMA CANAL AND THE NAVIGATOR.

Although the type of canal at Panama is probably definitely settled in favor of the lock system there continues to be more or less agitation and discussion of the subject not only in the daily press but to some extent in the technical, though it must be said that the latter almost unanimously support the decision in favor of the lock type. The opposition to it comes chiefly from a few engineers whose opinions were not given the weight to which they seem to think they were entitled and some of which are interested in special methods of prosecuting such work and which methods they advocate as a solution of the difficulties in the sea level type. On both sides the discussion has been almost wholly of an engineering nature and confined chiefly to questions of construction. The canal is presumably being built as a ship channel and not principally to settle differences of opinion between rival schools of engineers and it would seem as though its utility, or more properly fitness for the purpose intended, should cut some figure.

So far the men who are to use the channel seem to have been overlooked but it is they, and not the engineers, who will justify or confound the judgment of those who determined the type. We need not here discuss the arguments advanced by each side but will consider both types as they affect navigation.

First as to plan. The total length of canal is approximately 50 miles; in the sea level type about two-fifths of this is made up of curves, in the lock type about one-seventh. In the sea level type these curves are sinuous; in the lock type they merely represent the center line of the canal at the intersection of straight portions, or ranges; in actual navigation there is practically none, because the ship is kept steadily on one range until she closes the range on the next course, and where these shifts of wheel occur the channel is widened by the suppression of the interior angle to give abundant room to swing or pass another ship.

It is impossible to steady a ship on a constantly changing course, even in daylight, because there is nothing to steady her, leaving out of the question the influence of bottom drag of which we will speak later, and in this the army engineers who have had the benefit of long experience in laying out, constructing and maintaining ship channels as actually demanded by navigation, have evidenced the value of their experience. Navigation of such a channel at night, when even the bank is not visible is entirely impossible, whereas straight reaches with simple range lights are as easily negotiated by night as by day, so long as the lights can be picked up, even with a glass. Of course ranges on curves are not feasible and lighted buoys in a curving channel are altogether impracticable. In width of channel the proposed sea level type is little more than a continuous ditch, with a bottom width of 150 ft. The surface width has no bearing on the question whatever except in so far as it affects the flow of water past the ship, which we will discuss later. The lock type has a least bottom width of 300 ft. and this for only about eight miles; for about 22 miles 500 ft. width and for about 20 miles across Gatun Lake, as the water impounded by the great Gatun dam is called, it will be from 800 to 1,000 ft. wide. These widths allow even in the shallowest portions, of a considerable amount of swing, and human power has not yet been able to prevent this swing in narrow or shallow channels, even with no current. The narrower the channel the greater the tendency to swing, and as the ship always makes for the nearest bank, when "hunting" is once begun, it becomes increasingly more difficult to arrest, because of the increased angle of helm necessary to steady her. Passing other ships in such a channel is a matter of most serious difficulty, because the cross section of the two ships is such a large proportion of the total channel section that violent disturbing eddies and currents are set up, chiefly by propeller action, and it is very doubtful indeed if two 60-ft. beam ships, with the most careful and deliberate handling, could pass each other in a 150-ft. channel without rubbing. Anyone who has ever watched the effect on the water level in a narrow channel of even a slowly working propeller with a deep ship will readily understand the difficulty. Further, the great width provides ample room for a ship with temporarily disabled engines or steering gear to lie to an anchor off the ranges, whereas with the sea level type a ship must be kept moving or blockade the channel.

Second, as to depth. The sea level canal proposes a depth of 41 ft. and if the plans advocated by some were followed, this would only be at high tide and subject to a tide range of 10 ft. The lock type provides a least depth of 45 ft. and across Gatun Lake, a stretch of about 20 miles, it varies from 45 to 70 ft. The difference in speed due to reduced bottom drag will be very considerable, not only by reason of the reduced resistance but also the very much better steering possible with an additional 4 ft. of water. At low water the channel depth would be reduced to 31 ft., not even sufficient to float many of the ships which would

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probably use it, to say nothing of navigating

Third, as to currents. One of the advocates of the sea level type in a letter to *Engineering News* gravely states that the tidal currents set up in the canal and reaching about 3 miles per hour, calculated on the entire area of cross section of canal, would be no hindrance to navigation. He quotes instances of navigation in much higher currents, such as the lower Mississippi in flood, the North River at New York and some tropical streams navigated by flat bottomed light draught boats.

It is almost a waste of space to point out that maneuvering or steering a ship in a current is almost entirely a question of the relative volumes of the ship and the stream. A ship which could be driven and steered at full speed up North River in any current could not be driven one foot at full speed (as actually suggested) in a canal or narrow stream. For that matter a ship of say 60 ft. beam and 28 ft. draught could not be driven one hundred yards in the proposed sea level canal at full speed, even with no current whatever. And as a ship can only be steered as she has motion relative to the surrounding water, a vessel traveling *with* a 3 mile current would necessarily have an actual speed of something over that in order to have steerage way, say an additional 3 miles. The control of such a ship in a sea level canal under such conditions, to say nothing of meeting other ships, in a channel only 150 ft. wide and at which point the current is consequently greatly accelerated, is something which only a man devoid of practical knowledge would consider without a shiver. The author of the letter referred to quotes the Detroit River as an instance of navigating in a 4-mile current. There is no point in the Detroit River where such a current exists, but even admitting that it does it has no bearing on the case whatever. The Detroit River is wide, and except for a short distance at the lower end, relatively deep, so that speed is affected very little and except at one point, steering not at all, and this point is always navigated at slow speed.

The time occupied in lockages is more than made up by the greater facility of navigation in the lock canal but this time is not nearly so great as seems to be supposed. The average lockage at the Poe lock at the Soo is about 40 minutes, and although the locks at Panama are slightly larger than the Poe, the arrangements for filling and emptying will doubtless be in proportion, and probably better, so that the three lockages should not consume over three hours at most. It should be remembered too, that the larger the ship the smaller the volume of water to be handled and the shorter the time lost in lockages. The author referred to also speaks of the experience with accidents to locks at the Soo, while as a matter of fact there have been none of any consequence in the entire 54 years, as we have had occasion to note in a previous issue. We question if a navigator can be found who, when he fully understands both plans, will not unhesitatingly declare for the lock type, even though he may never have done any locking, while to those who have the problem has no terrors. It has been gravely argued that the locks or gates might be damaged by a ship being driven into them at high speed. Any one who has ever seen a large ship moved into a lock chamber must know that the only way to get her in at all is to shift her slowly and the larger she is the greater the difficulty—because the ship so nearly fills the gate that the impounded water which must be displaced by the ship can only find exit slowly through the contracted area past her sides and bottom. To a lesser extent the same condition exists in the sea level type of canal and any effort to obtain speed must not only result in failure but probably in disaster. The same argument holds true of course even in the much greater section of the lock-type but to a greatly lessened extent.

A GRAND DUKE TACKLES THE PROPELLER.

For a thing that has been improved and reformed so much and so often, the screw propeller is the most confirmed back-slider in the universe. The names of those who have become enthusiastic in the cause at some time or other is legion, and from Greenland's icy mountains to India's coral strand the hosts come to take a hand in the great uplift. The march of improvement exemplifies the definition of two parallel lines as those which constantly approach each other and never meet. Once more we are informed, and by *The Marine Engineer*, London, that the screw propeller is given another long lift on the way to perfection, and this time by no less a person, or as we suppose we should say, personage, than His Royal Highness the Grand Duke of Oldenburg.

Strange to say, H. R. H. has not decided that the vulgar type of propeller, so far as the shape and number of blades is concerned, is all wrong, wherein he differs from most of those great inventors whose deeds live after them and whose improvements in screw propellers have produced large revenues to the patent office and added to those on the waiting list, but he has discovered that the proper fore and aft position of the blades on the hub is the key to the whole miserable business. Instead of all the blades lying in the same plane they lie in different planes, so that a four-bladed propeller for instance, can lie four times as often as the common type. This excessive mendacity is only apparent, however, and not real, since H. R. H. assures us that by stepping the successive blades backward in relation to each other the ship is made to step forward, as it were, with great celerity.

Of course, slip is lessened; we regret that we are obliged to admit that H. R. H.'s excessive modesty does not permit him to claim outright that he has abolished it entirely, and the improvement in those instances where the new type has been applied is in no case less than 9 per cent, running up to 33 per cent. We may say here that in this respect the new propeller is right up to the mark, as all improved propellers are supposed to show some such range, otherwise it is at once apparent, even to a layman, that they would not be improvements. The stepping of the blades does this "by pre-

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venting the formation of a ring of empty spaces." We intended to represent this diagrammatically, but our artist who went out for a minute shortly after being given the assignment has not come back, and we are advised that he has developed alarming symptoms of dementia. However, our readers will of course readily understand what is meant.

The scoffer will doubtless suggest that in those instances referred to the performance must have been somewhat indifferent, but nothing will convince some people. To be sure, Joest in 1841 and Maudslay in 1848 anticipated H. R. H. but their failure was only to be expected in as much as they totally failed to grasp the ring of empty spaces, and besides they were not grand dukes. Why, the good ship Seidlitz, fitted with one of these propellers and driven presumably by Seidlitz powders—but what's the use?

THE CONTROVERSY OVER THE FLORIDA'S BOILER INSTALLATION.

The controversy which has arisen over the bids submitted for installing the boilers of the battleship Florida, now building at the Brooklyn navy yard, involves two entirely different types of water tube boilers and is interesting in that it compels the navy department to recognize the seemingly just claims of the newcomer in the field of battleship equipment. One type has to its credit battleship service extending over many years in the navies of the world, and has practically been the only type of water tube boiler installed in our heavier ships in the past few years. The other type has been successfully operated on torpedo boats, destroyers, and a monitor of the navy and has rendered satisfactory service wherever afforded an opportunity of doing so.

That the builders of the latter type of boiler are capable of coming up to specifications there can be little doubt; past experience and record would point that way. Their offer, also, to furnish a bond to indemnify the government in the event of the failure of their boiler to accomplish all that is required of it would demonstrate their confidence in this capability. On the other hand, the navy department can, to a certain extent, be excused for preferring to equip the new $10,000,000-battleship with boilers which have had the opportunity of proving their efficiency on ships of this type, although this logic is much in the same lines as that of the old lady who sternly ordered her boy not to enter the water until he had learned to swim.

It is a matter of record that the cost of installing the older type of boiler on the Connecticut was $3.91 per sq. ft. of heating surface. It is interesting to note that the bid for the Florida contract set the cost at $3.76 per sq. ft. of heating surface. In comparing the figures of the competing concerns a difference of $69,000 in cost and about 200 tons in weight of installation is shown in favor of the newer type. Hence it would appear that, everything else in the bids being satisfactory, only the desire to avoid innovations in battleship equipment would excuse the ignoring of the lower bidder by the board of construction.

It is claimed for the lighter boiler that it strongly resembles the Yarrow boiler, now much in favor with the British admiralty. Both are of the semi-vertical type and have two sets of tubes leading direct into the steam drum. In the American boiler there are a greater number of rows of tubes to each set, thus absorbing the heat more thoroughly with a corresponding lower stack temperature. In the British boiler the tubes nearest the fire side only are curved, whereas in the American boiler all the tubes are curved. Experience has proven that expansion strains are much better provided for when curved tubes are used, the British navy only adopting curved tubes after exhaustive tests with the Yarrow as a straight-tube boiler.

There are several advantages with the semi-vertical boiler as compared with the older type equipped with tubes resting in a semi-horizontal position, not the least of which is its adaptation for higher forced draft. There is also less likelihood of sediment depositing in the tubes. A comparison of details of construction between the two boilers under discussion shows that the newer type of boiler has much to recommend it from an engineer's standpoint. There can be no doubt, also, that the boiler which has enjoyed the confidence of the powers-that-be during the past few years has many commendable features. In opening bids for the equipment of a battleship, however, the layman could be excused for suggesting that, as both types of water tube boiler are known to the officer of the line, satisfactory comparisons of their individual merits be obtained first-hand.

There are several types of good water tube boilers on the market, though the builders may not be desirous of installing their product on battleships or the like. One type, again, should not have a virtual monopoly of the equipment of the bigger vessels of our navy, due to its having been tried out over several years and given efficient service. This would hardly seem to be fair to the others which have given satisfactory service in other classes of fighting ships or in the merchant service, and whose builders are desirous of earning in honest competition some of the money disbursed by the navy department.

SUMMER MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

Heretofore the Society of Naval Architects and Marine Engineers had held one meeting annually, usually in New York in November. At the last annual meeting it was decided to make a departure from this practice and hold an additional summer meeting, that for this year to be held in Pittsburg or one of the lake cities and an expression of opinion from members led to a choice of Detroit. The meeting point and the time has been fixed upon tentatively as between June 20 and July 20, but it is hoped that a definite date may be decided upon

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which will permit of a view of a launching of a lake steamer, as the method followed in lake launchings would be a novelty to a large proportion of the membership.

A committee has been appointed, consisting of Messrs. Frank E. Kirby, chairman, Harvey D. Goulder, Frank Jeffrey, Richard P. Joy, Robert Logan, Henry Penton, Antonio C. Pessano, H. C. Sadler and W. J. Baxter, secretary of the society, to formulate a program for the proposed meeting for the consideration of the executive committee of the society. It is to be hoped that the first summer meeting of the society will be most successful in every respect and will lead to the summer meeting becoming an established feature.

Lake Ship Yard Methods of Steel Ship Construction.

By Robert Curr

Fig. 47 shows the expanded shell plating for one side of the vessel from the spar deck stringer to keel in way of a water tight bulkhead.

This plan is similar to Fig. 43 except that it shows an inside view of the plating, while the other shows the outside. There are 159 rivets connecting the bulkhead frame to the shell plating. These rivets from the keel to No. 3 stringer are each spaced six diameters of the rivet apart. The balance being the usual pich. It will be observed that the number of rivets connecting No. 6 web frame to the shell plating does not exceed 91 rivets.

159 — 91 = 68 holes.

68 × 37/32 = 78.6 inches. The reduction of material being caused by punching.

In order to find the actual material reduced, reference must be made to the thickness of all the materials affected by the close punching at the bulkhead.

Fig. 48 shows the materials affected at the bulkhead, as well as the number of rivets in it. It will be observed that the close pitch of rivets does not extend above the tank side only far enough to insure watertightness in the vicinity of the tank side top.

The longitudinal girder plates and bottom angles are continuous. Longitudinal angles are not affected through this arrangement of watertightness as they have to be punched in any case.

TABLE SHOWING DIFFERENCE IN AREA OF SECTION CAUSED BY CLOSE PUNCHING.

	PARTS.	Area of punched material at web.	Sizes in inches.	Unpunched material.	Number of holes.	Diameter of holes.	Material for holes punched.	Sizes of punched material.	Area of punched material at bulkhead.
1	Keel plate	15.55	20x15/16	18.75	5	18/16	5.62	14.38x15/16	13.47
4	Center Keelson plate	28.19	60x 9/16	33.75	13	16/16	13.00	47 x 9/16	26.44
6	B. Strake shell plating	48.00	84x11/16	57.75	21	18/16	23.62	60.38x11/16	41.51
7	C. Straké shell plating	44.00	84x10/16	52.50	22	18/16	24.75	59.25x10/16	37.03
8	D. Strake shell plating	44.00	84x10/16	52.50	21	18/16	23.62	60.38x10/16	37.74
9	E. Strake shell plating	40.20	76x12/16	57.00	20	18/16	22.50	53.50x12/16	40.12
10	G. Strake shell plating	40.20	78x12/16	58.50	16	18/16	18.00	60 x12/16	45.00
11	H. Strake shell plating	36 09	70x10/16	43.75	20	18/16	22.50	47.50x10/16	29.68
12	J. Strake shell plating	38.67	72x10/16	45.00	18	18/16	20.25	51.75x10/16	32.34
13	K. Strake shell plating	38.84	69x11/16	47.43	15	18/16	16.87	52.13x11/16	35.84
14	L. Strake shell plating	48.60	62x15/16	58.12	12	18/16	13.50	48.50x15/16	45.41
23	Longitudinal Girders	54.08	167x 6/16	62.62	40	13/16	32.50	127 x 6/16	47.62
29	Tank top plating A	15.00	36x 7/16	15.75	7	16/16	7.00	29 x 7/16	12.68
30	Tank top plating B	29.50	70x 8/16	35.00	16	16/16	16.00	54 x 8/16	27.00
31	Tank top plating C	30.00	72x 8/16	36.00	17	16/16	17.00	55 x 8/16	27.50
32	Tank top plating D	30.00	70x 8/16	35.00	17	16/16	17.00	53 x 8/16	26.50
33	Side tank plating E	29.75	84x 7/16	36.75	20	16/16	20.00	64 x 7/16	28.00
34	Side tank plating F	27.00	86x 6/16	32.25	21	16/16	21.00	65 x 6/16	24.37
35	Side tank plating G	13.87	45x 6/16	16.87	13	16/16	13.00	32 x 6/16	12.00
36	Side tank top plating	30.00	66x 9/16	37.12	15	16/16	15.00	51 x 9/16	28.68
		681.54							618.93

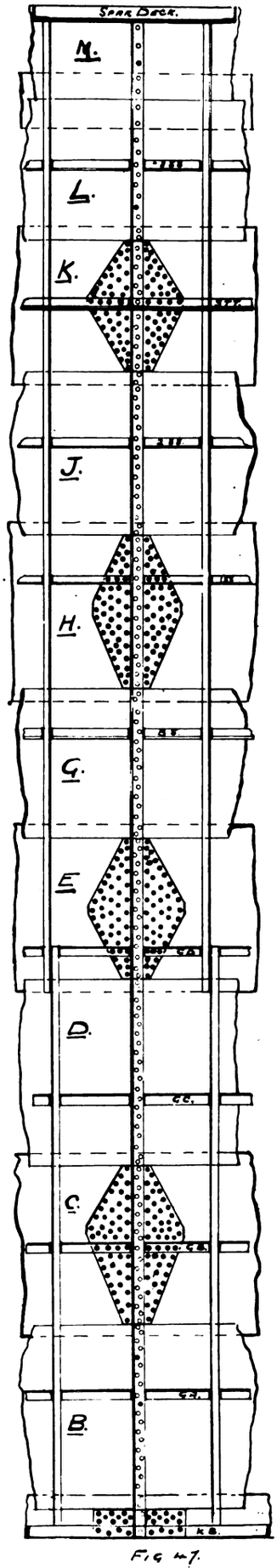

FIG 47.

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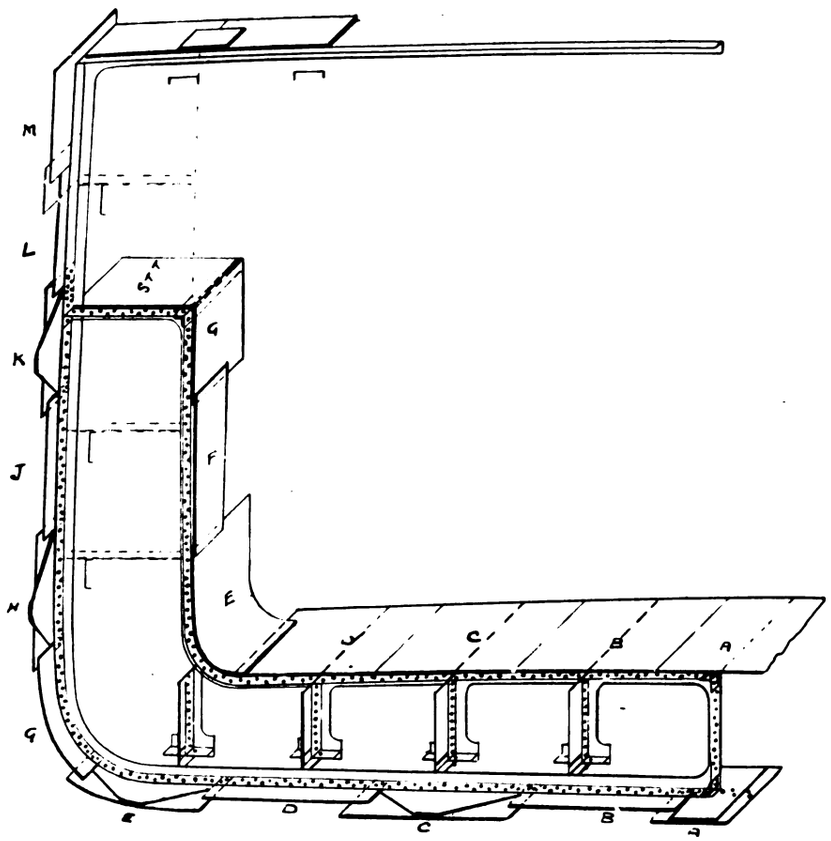

— Fig. 48. —

The materials affected are keel plates, center keelson plate, shell plating, B. C, D, E, G, H, J, K and L, longitudinal girder plates, tank top plating, A, B, C, D, E, F, G, and tankside top plating.

The accompanying table shows the difference in the area of section caused by the close punching of the materials for watertight work. Column No. 1 shows the area of section of the punched material taken from the table explanatory of Fig. 42.

Column No. 2 shows the sizes of material from the same table, as does column No. 3 for unpunched materials.

CALCULATION FOR NEUTRAL AXIS.

1.	2.	3.	4.	5.
Items—	Scantling in inches.	Area of section in square inches.	Distance of C G above keel.	Moment.
Keel plate	16.63 x 15/16	15.59	0.05	0.77
Keel plate angles	6.25 x 12/16	4.69	0.17	0.79
Shell plating B	69.36 x 11/16	48.00	0.15	7.20
Shell plating C and D	141 x 10/16	88.12	0.20	17.62
Shell plating E	53.50 x 12/16	40.12	0.70	28.08
½ center keelson	51 x 9/32	14.34	2.70	38.71
Girder angles	16 x 6/16	6.00	1.80	10.80
Girder plate	123 x 6/16	46.12	3.50	161.42
Shell plating G	60 x 8/16	40.20	5.00	201.00
Tank top plating A, B, C and D	209 x 8/16	104.50	5.14	537.14
Center keelson angle	5.50 x 8/16	2.75	5.20	14.30
Bilge stringer	7.00 x 7/16	3.05	5.30	16.16
Tank side strake E	53.50 x 12/16	40.12	7.30	292.87
Shell plating H	58.75 x 10/16	36.09	9.40	339.24
Side stringer No. 1	16.78 x 7/16	7.34	10.10	74.13
Tank side f	72 x 6/16	27.00	14.00	378.00
Shell plating J	61.88 x 10/16	38.67	14.80	572.30
Side stringer No. 2	16.78 x 7/16	7.34	15.20	111.56
Tank side G	37 x 6/16	13.87	19.00	263.53
Shell plating K	56.50 x 11/16	38.84	19.70	765.14
Tank side top angles	7.50 x 8/16	3.75	20.70	77.62
Tank side top plate	55 x 9/16	30.93	20.80	643.34
Shell plating L	51.88 x 15/16	48.60	24.80	1,205.28
Side stringer No. 3	16.78 x 7/16	7.34	25.40	186.43
Shell seam strap	19.50 x 1	19.50	27.50	536.25
Shell plating M	45.10 x 15/16	42.28	29.90	1,264.17
Channel girders	33.56 x 7/16	14.68	30.60	449.20
Spar deck angle	9.75 x 7/8	8.25	31.40	267.52
Spar deck stringer	120.30 x 1	120.30	31.60	3,801.48
Hatch coaming	15 x 7/16	6.50	32.40	210.60
		925.15	÷	12,474.64

Neutral axis above keel = 13.48 feet

Column No. 4 shows the number of rivets punched as per Figs. 47 and 48.

Column No. 5 shows the diameter of the rivets after being countersunk.

Column No. 6 shows the amount of material there is in the punched holes which has to be deducted from the unpunched material.

Column No. 7 shows the actual size and thickness of the material after deducting for punching.

Column No. 8 shows the area of punching material at the bulkhead.

The material for the section through the watertight bulkhead column No. 8, amounts to 618.94 sq. in. and has a value of 24 tons per sq. in.

$618.94 \times 24 = 14{,}854.56$ tons.

Column No. 1 shows the same materials with an eight diameter spacing of rivets with a value of 26 tons per sq. in. equaling $681.54 \times 26 = 17{,}720.04$ tons.

$17{,}720.04 - 14{,}854.56 = 2{,}865.48$ which must be made up, in order to maintain the strength of the vessel and make it equal to section through line of holes at No. 6 web frame.

Fig. 47 shows an arrangement of doubling the outside strakes of plating on the watertight bulkhead frame in order to overcome the reduction in materials by punching for watertightness.

In the arrangement shown on Fig. 47, the doubling plates have an area of 187.81 sq. in. with a value of 24 tons per sq. in. equaling 4,507.04 tons.

This exceeds the reduction by punching to the extent of 1,734.40.

The number of rivets must not be less than $\frac{2{,}865.48}{15} = 191$, which are shown on Fig. 47. Example: $168 \times 15 = 2{,}520$. $14 \times 26 = 364$. $2{,}520 + 364 = 2{,}884$ tons strength of rivets.

In the arrangement of rivets care must be taken to not have more in a line than are shown on Fig. 43. The rivets should be arranged about eight diameters, measuring from center to center of the holes, inside of the outside edge of the doubling and the frame angle holes.

Fig. 49 shows midship section of a vessel showing the structural material embraced in the equivalent girder and dealt with in the calculation for the neutral axis and moment of inertia, see Fig. 42.

The table showing calculation for neutral axis has the items for longitudinal girder in first column, scantling for punched material in second column, area of section in sq. in. in third column, distance of center of gravity above underside of keel plate

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in fourth column, and moment in fifth column.

Moment $\frac{12,474.64}{\text{Area of section } 925.15}$ equals 13.48 equals neutral axis above underside of keel plate.

Calculation of moment of inertia for hogging strain are shown in the table in columns as follows:

First column—Items in girder.

Second column—Section area in sq. in. A.

Third column—Distances of center of gravity from neutral axis h.

Fourth column—Squares of distances h^2.

Fifth column—Products of $A \times h^2$.

Sixth column—Depth of vertical webs d.

Seventh column—Squares of depths d^2.

Eighth column—Products $1/12 \times A \times d^2$

The sectional areas in the calculations are for one-half of the section of the vessel.

It is thus necessary to multiply the moment of inertia, column 5, for the half section by 2 in order to obtain the total moment of inertia.

The finding of the moment of inertia is the second stage of the calculation but before the stress upon either the top or bottom of the vessel can be ascertained, the bending moment must be found.

One-eighty-fourth the length of the load water line multiplied by the displacement in tons is found to give a fairly accurate approximation to the maximum bending moments experienced, and which is developed when the vessel is supported upon the crests of waves and enduring a hogging strain.

The vessel whose midship section shown in Fig. 49, and moment of inertia calculation is 532′ × 56′ × 31′ and has a displacement of 13,600 tons on a draft of 20 ft.

The neutral axis being 18.52 below the top of girder and 13.48 above the underside of the keel plate, the maximum tensional stress on the top of the sheer strake will be $\frac{86,133 \times 18.54}{145,464}$ equals 10.96 tons per sq. in.

And the maximum compressive stress on the bottom plating will be $\frac{86,133 \times 13.48}{145,464}$ equals 7.96 tons per sq. in.

10.96 × 2,000 equals 21,920 pounds the maximum tension on the top sides.

The breaking strength of the material is 62,000 pounds and elastic limit half of same 31,000 pounds. This gives approximately a factor of safety of three over the breaking strain.

Through the unreliability of rivet points I have been unable to find any authority on the value of a rivet in tension.

CALCULATION OF MOMENT OF INERTIA FOR HOGGING STRAIN.

1. Items in Girder—	2. Sectional area in square inches A.	3. Distance of C. G. from neutral axis = h.	4. Squares of distances = h^2	5. Products $A \times h^2$	6. Depth of Vertical webs = d.	7. Squares of depths d^2	8. Products. $1/12 \times A \times d^2$.
Keel plate and angles	20.80	13.00	169.00	3,427.32			
Shell plating B	48.00	13.30	176.89	8,490.72			
Shell plating C and D	88.12	13.40	179.56	15,821.72			
Shell plating E	40.12	12.40	153.76	6,168.85			
½ center keelson and angle	17.09	10.30	106.09	858.26			
Girder plates, etc	52.12	10.20	104.04	5,423.56	5	25	227
Shell plating G	40.20	9.50	90.25	3,618.05			
Tank top a, b, c and d	104.50	8.40	70.56	7,365.52			
Bilge stringer	3.50	8.30	68.89	210.11			
Tank side strake e	40.12	6.20	38.44	1,543.21			
Shell plating H	36.09	4.20	17.64	636.75			
Side stringer No. 1	7.34	3.50	12.25	42.87			
Tank side f	27.00	0.50	0.25	6.75	16	256	4,523
Shell plating G	38.67	1.20	1.44	55.68			
Side stringer No. 2	7.34	1.70	2.89	21.21			
Tank side g	13.87	5.40	29.16	304.04			
Shell plating K	38.84	6.20	38.44	1,493.00			
Tank side top M D	34.68	7.20	51.84	1,797.81			
Side stringer No. 3	7.34	11.80	139.24	1,643.03			
Shell L seam and M	110.38	14.00	196.00	2,034.48	11.00	121	1,187
Spar deck	150.00	18.00	3.24	5,832.00			
				66,794.91			5,937
				5,937			
				72,731.91 = moment of inertia for ½ section.			
				2 for both sides of vessel.			
				145,464 Total moment of inertia.			

Length, 532.
Breadth, 56.
Depth, 31.
Load draught, 20′ 0″.
Load displacement, 13,600 tons.

Maximum bending moment $\frac{W \times L}{84}$ = 86,133.

Moment of inertia, 145,464.
Neutral axis from top 18.52 } depth of girder
Neutral axis from bottom 13.48 }
Maximum tension on top, 10.96 tons.
Maximum compression on bottom, 7.96 tons.

In this article all the intercostals have been omitted. The hatch coaming has been considered but it is very doubtful if it is of any consequence in assisting the area of section seeing that it only runs to the hatch opening.

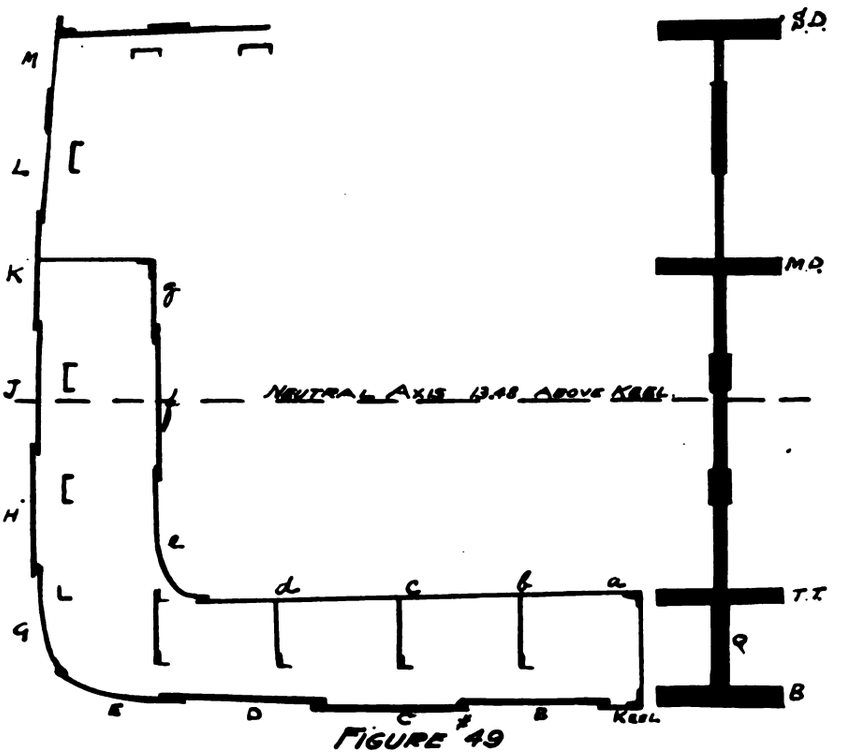

FIGURE 49

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Distribution of Cargo in Ore Carriers On the Lakes

The Address of Robert Logan, General Manager of the American Ship Building Co., Before the Masters and Officers of the Pittsburg Steamship Co.

DURING the past 15 years or so the size of lake vessels engaged in the ore or bulk freight trade has increased enormously, from some 3,000 tons to 13,000 tons carrying capacity, and from 300 to 600 ft. in length, involving many new features in type and construction, and making the question of the distribution of the load to be one of the very greatest importance, and one worthy of the most serious investigation. This is particularly so in the longer class of vessels, for the shorter vessel has naturally proportionately greater stiffness to resist distortion of form under the influence of loading, and because the stress arising from variation in the load fore and aft acts at so much shorter leverage.

The stresses producing strain on the hull resulting from the distribution of the load lengthwise of the vessel are the most severe to which the vessel is subjected, and iron ore being the principal cargo carried on the lakes, and the one which permits of all the greatest variation in distribution, it will be sufficient that the consideration of this subject be confined to the distribution of a cargo of iron ore in a fore and aft direction in a steel lake vessel.

Least Strain on the Hull.

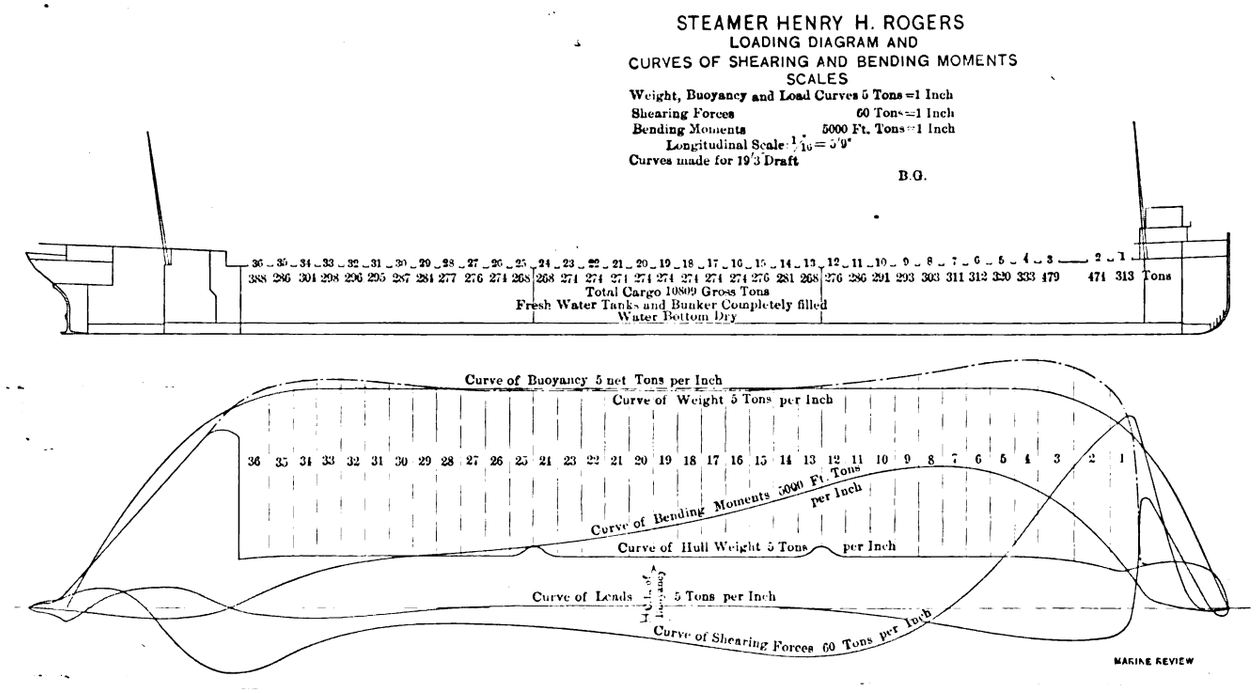
I think it will be conceded generally that the best distribution of the cargo load is the one that will cause the least amount of strain in the hull when the vessel is afloat in still water, for all such initial strains in the hull are just so much added to the strains that necessarily take place when the vessel is under the action of waves, consequently they ought to be avoided as far as possible. When a ship is floating at rest in still water the weight of the ship and the load therein is equal to the weight of the volume of water displaced, and in order that there may be equilibrium the center of gravity of the ship must coincide with the center of buoyancy of the water, but while the aggregate weights are equal, the component parts in the hull that go to make up the aggregate are not so arranged that at every point in the length of the hull of the ship the weight at that point is supported and balanced by an equal weight of water, if that were the case there would be perfect equilibrium and there would be no stress or straining action whatever, just as if the ship rested in a solid cradle.

At certain portions of the length the buoyancy or upward pressure is in excess of the weight or downward pressure at that place, and in all other portions of the length the conditions are reversed, the weight being in excess of the buoyancy, but, as already stated, the sum total of each are equal and opposite and balance each other.

The result of this unequal distribution of weight and buoyancy over the length of the ship is that sheering stresses are set up in the hull having a tendency to separate the parts at the points where the excesses change from weight to buoyancy, so that if the various parts of the hull were free to separate the parts having excess of buoyancy would float lighter and those having excess weight would sink deeper in the water, each part seeking its own equilibrium, but as they are not free to separate the materials forming the hull have to take and resist the strain thus caused.

Natural Tendency to Sag.

All modern lake vessels built to carry coarse freight in bulk, with the machinery aft, the accommodations in fore-


STEAMER HENRY H. ROGERS
LOADING DIAGRAM AND
CURVES OF SHEARING AND BENDING MOMENTS
SCALES
Weight, Buoyancy and Load Curves 5 Tons = 1 Inch
Shearing Forces 60 Tons = 1 Inch
Bending Moments 5000 Ft. Tons = 1 Inch
Longitudinal Scale 1/16 = 5'9"
Curves made for 19'5 Draft
B.G.
36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
388 286 304 298 296 295 287 284 277 276 274 268 268 271 274 271 274 274 274 274 274 276 281 268 276 286 291 293 303 311 312 320 333 479 474 313 Tons
Total Cargo 10809 Gross Tons
Fresh Water Tanks and Bunker Completely filled
Water Bottom Dry
Curve of Buoyancy 5 net Tons per Inch
Curve of Weight 5 Tons per Inch
Curve of Bending Moments 5000 Ft. Tons per Inch
Curve of Hull Weight 5 Tons per Inch
Curve of Loads 5 Tons per Inch
Curve of Shearing Forces 60 Tons per Inch
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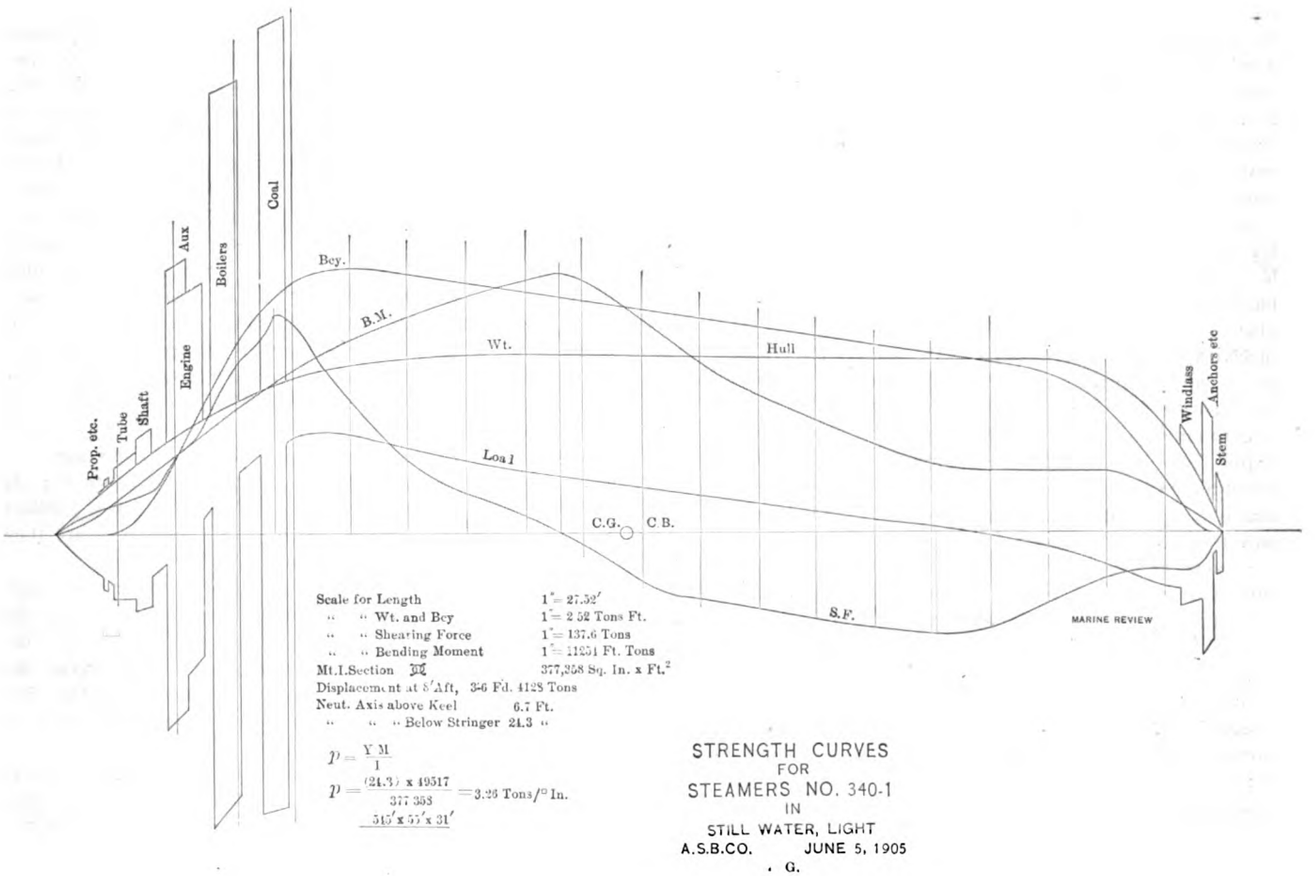

castle, have when loaded equally between those two points, or throughout the waist of the ship, a natural tendency to sag, in other words to draw more water amidships than at the ends, due to the fact that there is an excess of buoyancy over weight at both bow and stern, and particularly at the bow where there is a long empty space, which practically has no extra weight except that due to the windlass, chains and anchors, and throughout the cargo space there is an excess of weight over buoyancy, resulting in an upward pressure at each end of the ship and a downward pressure amidships, all tending to distort the form of the vessel by sagging and causing straining of the hull materials, the lower parts being put into tension and the top sides and deck stringer into compression, then when the vessel is unloaded the opposite conditions take place, there being an excess of buoyancy over weight amidships, the upper works are in tension and the bottom in compression. This continued reversal in the direction of the straining forces on the hull is a very severe test on the rivets and on the calking, not only because of the direct action of the tension and compression stresses but also because of the action of the forces arising from the sagging of the hull which tend to distort the form of the vessel or to alter the relations of depth and beam, the effects from the latter cause are mostly noticeable at the bilges because of the bellows-like action that takes place.

The Distribution of Load.

For purposes of illustration, I have taken two types of boats only, one 580 ft. long with 12 ft. center hatches, and 450 ft. long with 24 ft. center hatches, as being typical of lake craft engaged in the ore trade, as in similar vessels the distribution of the ore fore and aft will vary in the same proportion to the total load as is shown by the diagrams for the two types described, or to put it into figures, about 36 per cent of the load should be located in the forward third of the cargo hold, about 30 per cent in the midship third of the hold, and about 34 per cent in the after third of the hold, and this distribution will be found to give the minimum amount of strain on the hull, and at the same time give the vessel her proper sailing trim, 3 to 6 in. by the stern at the loading port.

In the case where there is an unusual space between the hatches, as for instance, in some boats with 24 ft. center hatches, two of the hatches may be 36 ft. apart centers; and in other 12 ft. centers, there is often one hatch omitted, making two of them 24 ft. centers, the load that would otherwise go into this space should be distributed in the two adjacent hatches so as to center it as nearly as possible where it belongs.

A point in connection with the 12 ft. center hatch boats is the fact that it is not necesary to load each hatch with its allotted number of tons so long as the sum total in two adjoining hatches is correct, for with this close spacing of hatches, when the ore is first loaded into alternate hatches it will run and meet together under the hatch between the alternate, probably to a depth of from 4 to 6 ft, with the result that there may be only half the amount of ore that was put into the alternate hatches need be put into this intermediate hatch, as it is, already has had the other half from the hatch on either side of it.

Similar Treatment for Tow Barges.

In the case of tow barges of the usual form the loading ought to be similar to that given for steamers, the heaviest weights at the two ends, but in the case of whalebacks, either steamboats or tow barges, that have their model very much cut away forward with a consequent loss of buoyancy at that point, the proportions for the dis-

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tribution of the load should be about 34 per cent of the total in the forward third of the whole space, 31 per cent in the midship third and 35 per cent in the after third; in all other respects the whalebacks are working under the same conditions as other vessels.

In giving these figures in regard to loading I may say that they have not been arrived at by opinion or arbitrarily, but by calculation from rules and formulae that have been proved correct by investigation and actual experiment, and in submitting them to you I fully appreciate the fact that owing to varying circumstances at the ore docks it is hardly ever possible to meet this distribution exactly, but if it is approximately as nearly as possible the hull will then, as far as unnecessary strains are concerned, be in the best condition that can be looked for.

Sailing in Light Condition.

When sailing light or without cargo another condition is met with and one entirely peculiar to lake vessels propelled by steam. When good weather prevails all that is aimed for under these circumstances is to get the propeller wheel under water and if the weight of the machinery, boilers and fuel all in the after end are not sufficient for this, enough water is run into the after tanks until the boat may be drawing from 14 to 15 ft. aft and nothing at all forward, giving the draft of 7 to 7½ ft. amidships, and in this condition the vessel is subjected to a hogging strain, having an upward pressure at each end due to their weights not being entirely supported by the water. This condition is not very severe on the ship in calm weather, but in any kind of sea strains may be extremely severe and even dangerous. It may also be greatly aggravated by a wrong manipulation of the water ballast when it is desired to sink the bow. This ought always to be done by flooding the ballast compartments from aft to forward until the desired draft forward and aft has been obtained and never by floating the ends and leaving the midship compartments empty.

There are no other points I can think of to take up with you in connection with the loading of lake vessels further than to say that it is not my purpose in advocating a correct distribution of the load to suggest that our lake vessels need any greater care taken in the handling than does any other structure built of steel or other materials, but I do wish to ask your attention to the fact that wrong treatment or abuse can be the cause or destruction in part or in whole of anything there is, and particularly to engineering structures of this class. (Applause).

Discussion of Mr. Logan's Address.

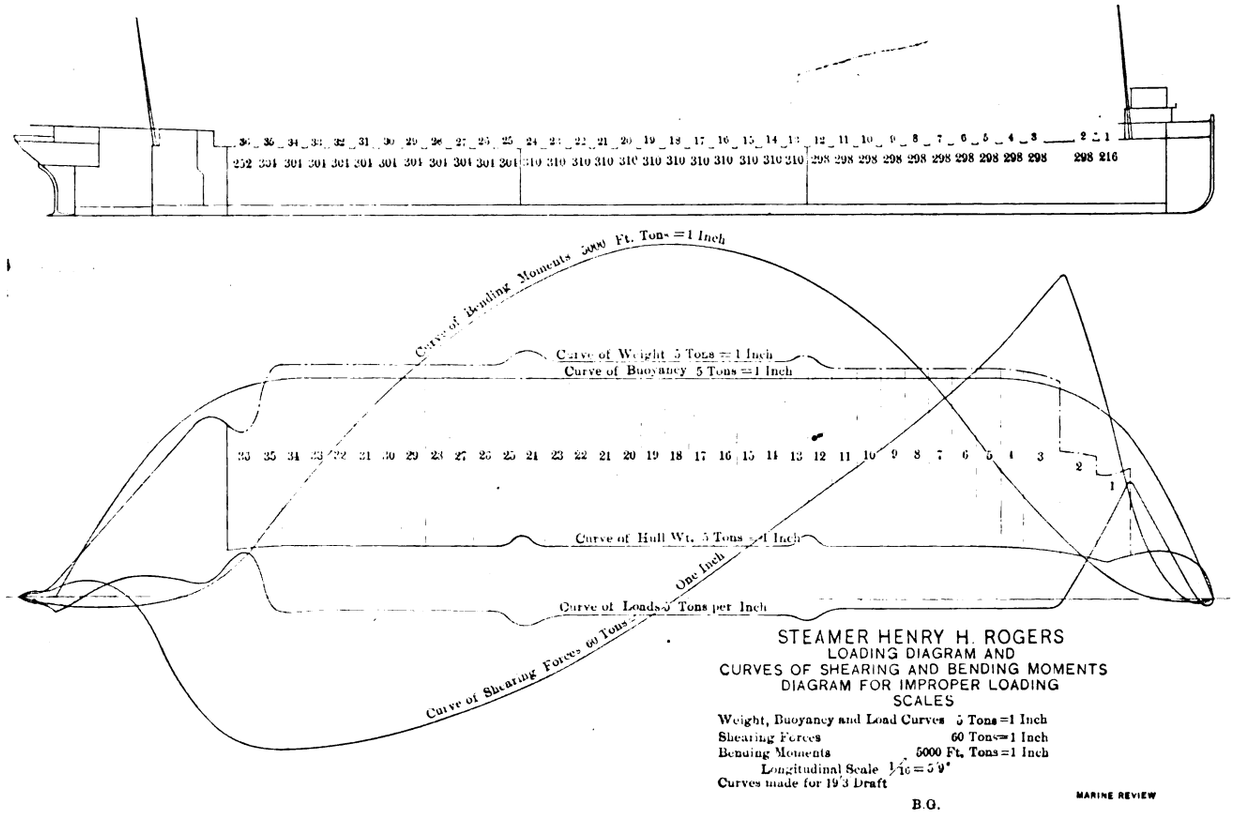
Mr. Coulby—Would that distribution you have given by percentages on the thirds of the cargo hold—would that be effected to any marked degree by the size of the ship or does it obtain on anything down below the 600 ft. boats? That is, some of our boats have more buoyancy than others, for instance, the Bessemer boats where there is a hatch forward of the pilot house—now is the buoyancy in percentage practically the same, that is, do we get close enough on those percentages from the forward to the after bulkhead regardless of the location of the houses?

Mr. Logan—These percentages I have given you are approximate for all classes of boats on the lakes. When we get down to the smaller boats they cut in more.

Mr. Coulby—If they take those percentages on all these boats from the forward to the after bulkhead, disregarding houses, etc., and make the division equally through in thirds, they have got as practical a distribution as can be made?

Mr. Logan—Yes sir. Figure it from where the ore will naturally trim forward to where it will naturally trim aft.

Mr. Coulby—Now, gentlemen, you have all heard this very able and carefully worked out paper by Mr. Logan. If anybody would like to ask Mr. Logan


Curve of Bending Moments 5000 Ft. Tons = 1 Inch
Curve of Weight 5 Tons = 1 Inch
Curve of Buoyancy 5 Tons = 1 Inch
Curve of Hull Wt. 5 Tons = 1 Inch
Curve of Loads 5 Tons per Inch
One Inch
Curve of Shearing Forces 60 Tons
STEAMER HENRY H. ROGERS
LOADING DIAGRAM AND
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Longitudinal Scale 1/16 = 5'0"
Curves made for 19'3 Draft
B.G.
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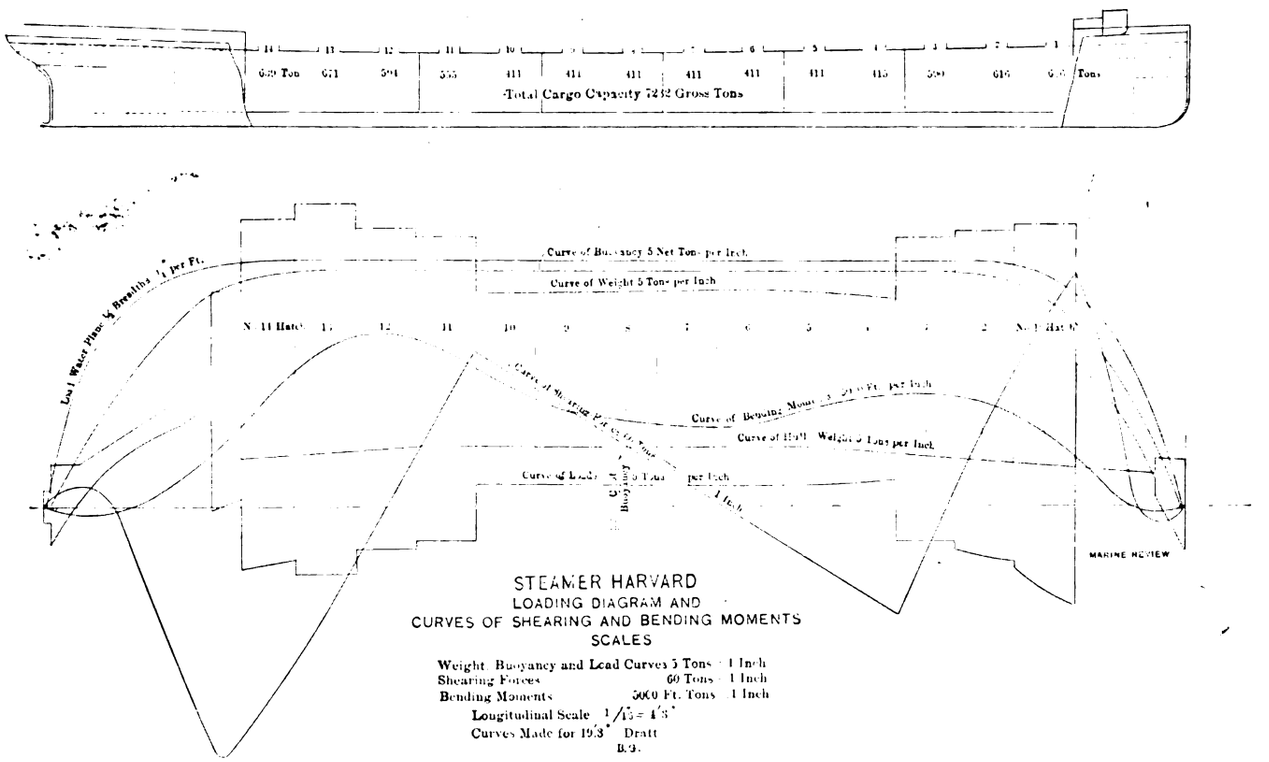
Total Cargo Capacity 7282 Gross Tons
Curve of Buoyancy 5 Net Tons per Inch.
Curve of Weight 5 Tons per Inch
Curve of Bending Moment
Curve of Half Weight 5 Tons per Inch
MARINE REVIEW
STEAMER HARVARD
LOADING DIAGRAM AND
CURVES OF SHEARING AND BENDING MOMENTS
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Weight Buoyancy and Load Curves 5 Tons = 1 Inch
Shearing Forces 60 Tons = 1 Inch
Bending Moments 5000 Ft. Tons 1 Inch
Longitudinal Scale 1/15 = 1'6"
Curves Made for 19'3" Draft
B.W.

any questions, if there is any point that is not clear, I would very much like to hear from you, because I regard this matter as the feature of this convention. I regard it as one of the most important things we have before us. You all know just as well as I know that there are ships on our lakes today that are exact duplicates, built on the same model, and that some of these ships are carrying from 100 to 200 tons more on the same draught than their sister ships. Now I think I know, from the talk Mr. Logan has given us, why they are doing it. We are not aiming in the steamship company to have any one of our ships carry a greater load seemingly on the same draught than any other ship in her class. What we are particularly interested in is giving the structure of our ships fair treatment and not bringing any unnatural strains on the ships. I am after the life of the ship. You may go and belly these ships and in the course of the season carry 1,000 tons more than a sister ship, and then it is a case of turning her over to the shipyard and letting them fasten her up at a cost of something like $20,000. I fail to see where this is very profitable business, and I would rather you would take care of them all the time. I

Capt. Cullen—If a boat has been bellied will she come back?

Mr. Logan—Sometimes. If she won't go back by putting her on keel blocks, you would have to knock out the rivets and re-rivet her.

Capt. Cullen—When I sailed the Poe she was bellied down 3½ in. the first load we put into her. We lightened up 150 tons in the five middle hatches, and got her up half an inch. Then we lightened up 50 tons more and still had 3 in. belly, but the minute her engine was checked down she would vibrate as she had never done before, so I put her back to the 150 tons amidships and she still had 3 in. of a belly. She didn't start taking this until she got down to the 14 ft. mark.

Mr. Logan—The probability is she has now got set and if you tried to bring her back you would loosen her up.

Capt. Bailey—Now we have loaded the boat, let's unload her. We have to distribute a lot of water in the forward end to unload them.

Capt. Woodford—Is there any objection, Mr. Logan, to loading a boat heavy in every other hatch, that is, a 12 ft. center hatch boat?

Mr. Logan—No, sir.

Capt. Olson—Suppose you are loading coal in one of the 440 ft. boats, you have got to fill them up from stem to stern in order to get them down to the marks. Would that naturally effect the strength of the boat any to have it distributed evenly right through?

Mr. Logan—Yes, that would throw more strain on her than if you could load the ends heavier, but that you couldn't avoid with coal.

Mr. Coulby—The point that Bailey makes is, that when these boats are at the ore docks and they are being unloaded, I suppose, of course, the cargo should be taken out of them fairly even. We have got to use water to hold them down, but that would only be a temporary strain.

Mr. Logan—That wouldn't affect her materially like in a sea.

Mr. Coulby—Where she would get her bumps would be by taking her outside; the more she was racked around, the more strains she would be subjected to. It is just like a building in the course of construction—you bring excessive strains upon the different parts until you finally fasten them all up.

Mr. Logan—Yes, if you should send her out among the waves with a few inches belly on her she would be still further strained.

Capt. Jollie—We are handicapped a little on this unloading business. The boats are so high that the rigs won't clear, and we are handicapped to about 50 in. of water. We dare not put any water in aft as it leaves her bow too high, and even if it wasn't for this, we dare not do it on account of the leaky tanks. This virtually brings nearly all the weight on the forward end of the boat.

Mr. Coulby—Well, that is only tem-

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porary and it is done while the ship is perfectly still.

Capt. Morgan—Suppose you go to Lorain where the dock is on a circle. The water is low—I am calling your attention now to the Cole—you get up there and her bow is off about 10 ft. from the dock; likewise her stern is off 10 ft., so they can't get any rig in there at all. They will take and work two hatches forward and two aft and they take enough out to lighten her up so she will come close up to the dock, but during that time they put a 10 in. belly in her, and it takes them 12 hours to do that.

Mr. Logan—If you continue that it will hurt her. If it is only done once I don't think it would, but if done continually it will.

Capt. Leisk—We get about the same thing at the North Dock at Chicago, where we make 10 or 20 trips a season. How about that?

Mr. Logan—Well, it is not good for the ship.

Capt. Culp—If you are light in a sea way, will it hurt to put water in the fore peak?

Mr. Logan—No, not if you have your tanks full. You had better put water in the fore peak than to have her pound.

W. W. Smith—But in some cases they pump it in 15 or 20 ft. in the fore peak.

Mr. Logan—That won't hurt the vessel any so long as the water bottom is full.

Capt. Story—Has the water the same lifting power if you have only 1 ft. under her as if you have 20 ft.?

Mr. Logan—Just the same.

Capt. Lowe asked Mr. Logan if it would be advisable to try to take a twist out of a boat if she had come from the ship yard that way.

Mr. Logan—I would just leave her with the twist in and I wouldn't try to take it out.

Capt. Lowe—Say a boat is loaded to her marks aft and she has 1 in. to 6 in. list outboard, away from the dock. Would it be a fair thing to take that out of her on the forward end with plenty of room to square her up?

Mr. Logan—No. Except if the twist had already been put into her by the loading, it might be all right to take it out of her anywhere in the rest of the boat.

Capt. Morgan—Say they let more ore run in than you wanted to go there and you couldn't help it, and you can't put any more in there to straighten her up because she would be too deep; will it be all right to put ore in forward to straighten her up?

Mr. Logan—Well, if that gave her a twist I do not think it would be enough to hurt her. She would have to stand a lot of wringing out in a quartering sea to hurt her.

One of the captains asked: In loading if you only take a little in the two after hatches and then have to shift, how much would it be safe to take in those two hatches so as to save as many shifts as possible?

Mr. Logan—You can take one-third to one-half of their capacity. I wouldn't fill them up more than this to begin with.

Capt. Cullen—You would be in still water and it wouldn't be any different from unloading her.

Mr. Logan—Well, if you should put the full load in those hatches and started loading forward, you would be putting a back-breaking strain in her.

Capt. Cullen—Wouldn't that same breaking strain be put in in unloading her?

Mr. Logan—Yes, but as I said before, if only for an hour or so, it wouldn't hurt her.

Capt. Bailey—Would six hours hurt her?

Mr. Logan—No, I don't believe six hours would. After a time it will hurt, but as to just what length of time, nobody can tell.

Capt. Morgan—Say your boat has a belly in her of from 1 in. to 10 in., what is it that gives? Everything is supposed to be solid on the start out.

Mr. Logan—It is the general structure, captain. The steel will allow quite a little stretching; it has elasticity. You have quite a length of material to come and go on in a boat 500 ft. long. It pulls on the rivets and holes and it will tend to hurt them, although you won't notice it, but the most of it is taken up in the material.

Capt. Parke—Mr. Logan, isn't the reason a ship sags in the middle because every square inch of that ship has to support the iron ore, irrespective of where the iron ore is in the ship?

Mr. Logan—No, she doesn't support it that way. That would be the ideal condition if she did.

Capt. Parke—Isn't the reason a ship sags because every square inch of that ship doesn't support its proportion of the ore? My ship, for instance, from the after hatch to the stern is 80 to 90 ft. Now the weight of her hull and machinery in that space is a very small proportion of the amount she has to carry forward of this space, so therefore, we have to stack the iron ore back up against the bulkheads aft so as to prevent her from sagging. The idea is that the square inch back under the engine room has to carry its proportion of iron ore if you are going to keep the ship on an even keel.

Mr. Logan—Yes, of course, you have got to pile it up there to take care of the surplus buoyancy there.

Deepening the Channels of the Great Lakes

ESPECIALLY illuminating are the reports of government engineers upon the steady reduction of the freight rate coincident with the deepening of lake channels. Brigadier General Marshall, chief of engineers, stated that the saving in freight rates alone on lake Superior during 1907 exceeded by over $25,000,000 the entire appropriations for the improvements of the channels of the great lakes from Niagara Falls to Duluth since the formation of the government. When the channels were 10 ft. deep the freight rate on iron ore was $3 a ton; at 20 ft. the freight rate was 65 cents a ton. The cost of moving freight on the great lakes per ton mile is less than one-tenth of a cent. The rail rate is from three to five times that. Multiplying the difference by the amount of freight moved the enormous advantage of the waterway is seen at once. A few years ago the government started to maintain a uniform depth of 20 ft. throughout the entire lake system. This depth has been realized though the fluctuations in the water level caused by winds do not always render it available. The new Livingstone channel will when completed have a depth of 22 ft. and in course of time the other channels will doubtless have a corresponding depth.

In point of fact there should be constantly kept in mind an ultimate available draught of 25 ft. This is somewhat in the future, to be sure, but there should be steady development towards it as the advantage of such a channel would be enormous. President Livingstone of the Lake Carriers' Association in his annual report for 1906 stated that no expenditure has ever

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been made by the government that has yielded such dividends as the money invested to improve the channels of the great lakes. The very next year the commerce of the lakes increased practically 50 per cent over the commerce of any preceding year, making the saving tremendous.

To be sure, there is a vast difference in the cost of constructing a 22-ft. channel and a 25-ft. channel. A 22-ft. channel would cost approximately $8,000,000; a 25-ft. channel approximately $26,000,000. Obviously before a 25-ft. channel could be secured a 22-ft. stage would have to be reached. General Charles E. L. B. Davis just before his retirement as government engineer with headquarters at Detroit earnestly recommended the prosecution of work to obtain a draught of 22 ft. His initiative should be followed with the thought ever in mind of deeper draught yet. Some of the lake cities are developing their inner harbors to a depth of 25 ft., and whatever is done by municipalities in the inner harbors should be supplemented by the government in the outer harbor.

NORTH SEA.

Five Lake Launchings

FIVE LAUNCHings have occurred on the great lakes within the past two weeks. The bulk freighter Alpena was launched from the Wyandotte yard of the American Ship Building Co. on March 24 for the Michigan Alkali Co., of Detroit, and was christened by Miss Stephanie Moran. This vessel is intended to carry crushed stone from the Michigan Alkali Co.'s quarries near Alpena to its plants in the lower Detroit river.

The Alpena is 374 ft. long, 47 ft. beam and 26 ft. deep. She will have quadruple-expansion engines, 17½, 25½, 37 and 54-in. cylinder diameters by 36-in. stroke, supplied with steam from two Scotch boilers 13 ft. 2 in. by 11 ft. 6 in.

The package freighter North Sea, building for the Mutual Transit Co., of Buffalo, was launched from the Ecorse yard of the Great Lakes Engineering Works on Saturday, March 27. She is a sister ship of the North Lake, which was launched at the St. Clair yard of the Great Lakes Engineering Works two weeks previously. Miss Lora Adrienne Evans, daughter of the auditor of the Mutual Transit Co., was sponsor. The North Sea is 372 ft. over all, 350 ft. keel, 46 ft. beam, and 30 ft. deep. Her engins are quadruple-expansion, 19, 27½, 40 and 58-in. cylinder diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 11 ft. 6 in. by 11 ft. 6 in.

The bulk freighter Denmark was launched from the Toledo Ship Building Co.'s yard at Toledo on March 27 for R. P. Ranney, of Cleveland, and was christened by Miss Florence Calder, daughter of Mr. Charles B. Calder, general manager of the ship yard. The Denmark is 460 ft. over all, 440 ft. keel, 56 ft. beam and 28 ft. deep. She has triple-expansion engines, 22½, 36 and 60-in. cylinder diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 14 ft. 6 in. by 11 ft. 6 in.

The American Ship Building Co. launched two vessels on March 27, the Andrew S. Upson at the Lorain yard and the LaBelle at the Cleveland yard. The Upson is building for Mr. Rufus P. Ranney, of Cleveland, and was christened by Mrs. F. H. Rose. The Upson is 400 ft. over all, 380 ft. keel, 52 ft. beam, and 28 ft. deep. Her engines are triple-expansion, 21, 33½ and 57-in. cylinder diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 13 ft. 9 in. by 11 ft. 6 in.

The LaBelle is building for the LaBelle Steamship Co., the transportation end of the LaBelle Iron Works, of Steubenville, O., and was christened by Miss Mary Eleanore Wright. The new steamer is 524 ft. over all, 504 ft. keel, 54 ft. beam, and 30 ft. deep. She has triple-expansion engines, 23½, 38 and 63-in. cylinder diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 14 ft. 6 in. by 11 ft. 6 in. The LaBelle will be managed in the office of M. A. Hanna & Co.

Lake launchings so far during 1909 are shown in the table accompanying.

NEW STEAMER FOR NORTHERN MICHIGAN TRANSPORTATION CO.

Plans have been prepared by Nevins & Smith, marine architects and surveyors, of Chicago and Cleveland, for a new exclusively passenger steamer for the Northern Michigan Transportation Co. of Chicago. Nevins & Smith have recently opened a large drawing office at the Chicago headquarters with a very competent staff who will devote all their time to designing, making working plans and complete specifications for all classes of tonnage.

The new vessel for the Northern Michigan Transportation Co. will be built to come out in June, 1910, for their Northern Michigan run between Chi-

LAKE LAUNCHINGS SINCE JAN. 1st, 1909.

AMERICAN SHIP BUILDING CO.

Where Built.	Type.	Name of Vessel.	Length Over All.	Carrying Capacity Gross Tons.	Name and Address of Owner.
Lorain	Freighter	Alva C. Dinkey.	600	13,000	Pittsburg Steamship Co., Cleveland, O.
Cleveland	Pass Str.	Tourist	85	.....	E. J. Dodge, Put-in-Bay, O.
Lorain	Freighter	E. J. Buffington.	600	13,000	Pittsburg Steamship Co., Cleveland, O.
Wyandotte	Freighter	Alpena	374	5,000	Michigan Alkali Co., Wyandotte, Mich.
Lorain	Freighter	La Belle	524	9,500	La Belle Iron Works, Steubenville, O. M. A. Hanna & Co., Mgrs.
Cleveland	Freighter	Andrew S. Upson	400	7,000	Rufus P. Ranney, Cleveland, O.

GREAT LAKES ENGINEERING WORKS.

Ecorse	Freighter	Clifford F. Moll.	464	8,300	American Steamship Co., Boland & Cornelius, Mgrs., Buffalo, N. Y.
St. Clair	Pkg. Frtr.	North Lake	372	5,000	Mutual Transit Co., Buffalo, N. Y.
Ecorse	Pkg. Frtr.	North Sea	372	5,000	Mutual Transit Co., Buffalo, N. Y.

TOLEDO SHIP BUILDING CO., TOLEDO, O.

Toledo	Freighter	Denmark	460	9,000	R. P. Ranney, Cleveland, O.

MANITOWOC DRY DOCK CO., MANITOWOC, WIS.

Manitowoc	Pass Str.	United States	215	1,298	Indiana Transportation Co., Chicago, Ill.

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cago and Mackinaw. She will be a twin-screw with quadruple-expansion engines, developing about 7,000 I. H. P., and 10 Scotch boilers. Her principal dimensions are 385 ft. over all, 360 ft. between perpendiculars, 50 ft. beam and 28 ft. molded depth, and is expected to maintain a sea speed of 20 miles per hour. She is several feet longer, and has one more deck than any screw propelled passenger steamer on the great lakes.

There are six decks, viz: the lower, main, saloon, upper, promenade and shade decks; on the last four named are 341 staterooms and parlors with berths for 700 saloon passengers. Twenty-two of the rooms are parlors or bridal chambers lettered from A to Z, omitting undesirable letters. The parlors on shade deck have bay windows from which a view ahead or astern can be obtained, a private balcony all around those rooms, and each suite has private bath room. Hot and cold water will be installed as part of plumbing in every room on boat, electric call bells, and sanitary couches in parlors in addition to the brass framed beds.

The vessel will be lighted throughout with 1,600 lamps of 8, 16 and 32 candle power and equipped with a powerful 5,000 candle power searchlight projector. The officers and crew will number 256 souls, the quarters for crew being on lower deck forward and aft of the machinery and boilers. On the main deck, the whole forward portion is occupied by galley and pantry, the after end by social hall, purser's office, cloak room and deck cafe. The midship portion of main deck is reserved for the stowage of about 1,000 traveling trunks.

The saloon and upper decks, in addition to their complement of staterooms, show ample accommodation for shelter and lounging on divans, settees and easy chairs. The promenade deck, in addition to the complement of staterooms and parlors, has a wide sheltered promenade all around the vessel. The shade deck is reserved for only a few choice parlors abaft the captain's room and chart room, and all the life boats, rafts and life saving appliances, including the Marconi wireless telegraph equipment.

The dining saloon is on forward end of saloon deck and extends across the full width of vessel by about 90 ft. long, with accommodations for 250 at one sitting. A system of artificial mechanical ventilation has been laid out for dried air through nickel plated ornamental funnels, all easily adjusted to direct the current to any desired direction, or shut it off at will. The air is cooled to within 2 degrees of the temperature of the water through which it passes before delivery to spaces ventilated.

The demand for a vessel of this size, class and capacity is very pressing for the Mackinaw route, and the plans to place such a vessel on that run show considerable enterprise on the part of The Northern Michigan Transportation Co. They at present own and operate among other vessels the S. S. Manitou, S. S. Missouri and S. S. Illinois, all first class steel passenger boats. The rapid strides in this company's business was very aptly expressed by an old marine man recently when he said that it seemed but a short time since they used "red table cloths and paper napkins."

A LAKE MASTER ON "THE STEERING OF THE SHIP".

Editor MARINE REVIEW.—I was much interested in the article on "The Steering of the Ship" in the REVIEW recently. The writer certainly understood steering gears, for he mentioned a number of points that never occurred to me before but which I know are right and I am sure he knows what steering a ship is. I think it would be worth while if every watch officer and wheelsman too to read it carefully and remember it. The explanation of slack or lost motion and its effects is fine and anybody can understand it and I for one intend to overhaul my gear thoroughly at once. It has been in service about four seasons now and I feel sure that a part of the poor steering I have been getting the past two years is due to that very thing. I do not agree with the plan suggested for keeping steady for I do not believe it can be done, but that is not important, we can soon find out whether it can or not. The amount of broadside movement possible on a long course on account of poor steering is no comfort, but I can see easily enough how it can be done, only I think that an average swing of one-eighth of a point is away below what is generally had. With the pilot house right up in the eyes of the ship it is pretty hard to catch the beginning of a swing and in thick or hazy weather you have only the compass card to steady by and I know from observing carefully in clear weather that a ship will often swing off an eighth before the card begins to move at all. What we need is some form of gear which will do away with all slack, like the old-fashioned hand-purchase, but of course worked by steam or power.

I had a telemotor one year and it does away with most of it and the wheelsman can feel his rudder all the time, but it is necessary to come amidships frequently to be sure the gear is central, and if there is the least leakage past the pistons or anywhere you are in trouble every minute. Please send me two or three extra copies of that article if you have them. I want my mates and wheelsmen to keep it handy.

Very truly yours,
LAKE MASTER.

(Lake Master is mistaken in supposing that with the telemotor the wheelsman can "feel his rudder". What he feels is the resistance of the springs at the transmission end, and which gradually increases from the midship to the hard-over position. It is not necessarily an indication of the rudder position at all. While it is true that the telemotor eliminates a part of the slack, that existing in the parts between the transmission cylinder and the reverse-valve, in the righting gear, the lap of the valve, and the taking up of the chain, exist with it just as with other gears, and if the system contains any air whatever the lost movement may be in excess of other types of gear. The lost movement can in no case be less than that needed to overcome the valve lap, no matter what the type of gear, but that is so very little that if other losses were eliminated it would be practically a hand purchase gear in responding to wheel movement.—EDITOR.)

SHIP YARD AT ASHTABULA.

Ashtabula has always been regarded as a desirable location for a ship yard. Latterly it has grown even more advantageous owing to the enormous investments made there by the Lake Shore and Pennsylvania railways to develop the port as their ore terminal. During the past four years the railways have expended about $7,000,000 in developing the harbor. There is a reason for this—the haul is shorter to the furnaces. Ashtabula will grow in importance as an ore receiving port. It follows obviously that the railways are as much interested as the steamship companies in the proper care of vessels at that port. To be self-contained Ashtabula should have a shipyard. Overtures have been made by the railways, in conjunction with the chamber of commerce at Ashtabula, to the Great Lakes Engineering Works of Detroit, to establish a shipyard at that point. While no corroboration has been received of the proposed plans, it is generally regarded in well-informed circles that a shipyard will be established at that point.

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Mr. Casey Makes a Few Remarks.

With apologies to Mr. Dooley.

"I'M THINKIN," said Mr. Hooligan, "th't fr'm what Sailor Bill an' thim guys says, us union men can ayther wur-rk with th' bloody scabs 'r git ashore."

"Y'r perception does ye credit", said Mr. Casey, "sure, I've said manny's th' toime thut wanst in a while y'r intilligence wuz almost human. If yez hadn't kept so clos't to Connors' place whin yez wuz ashore ye cud uv seen ut comin' anny toime this tin year. An' its shtrange too f'r ye cud ginerally see more afther a visit to Conners' thin before. But ye can't be gettin' ashore unless y'r aboord first, an' have ye thought uv that, me lad? An' th' scab's a poor crayther for sure. There's a lot uv him around in th' spring but he seems mostly to be wan because he hasn't paid his dues. Whin he's 'arned th' price of a car-rd he wants to know all about who he's wur-rkin' with. Who's th' tarrier on th' nixt watch, he says. I'll thry the high sign on him, he says. He blows the suds off a cup of wather an' th' felly don't let on. I'll thry th' new password, he says. Pilsener, he says. Not havin' had a dhrink wid th' bizness a-agint th' tarrier's not posted. He's a bloody scab he says, an' I'll not wur-rk wid him, he says. That is unless I c'n borry a quarther fr'm him, he says. So to save throuble and quarthers th' scab takes his car-rd whin he gets his fir-rst pay, an' all is fine again.

"It's too much prosperity that's botherin' ye, Hooligan. See what me frind Jawn D. says. He's bin persecuted all his life an' that's th' reason he's had riches for-rced on him an' now th' grocer'll thrust him till Saturda night. Th' big wans has bin comin' so fast an' there wuz so much f'r iv'rybody to do that nobody paid anny attinshun to ye, an' whin ye kicked because th' cook giv' O'Hara a bit th'most of th' dar-rk mate, an' him wantin' white annyhow; 'r because th' chief wanted ye t' bear a hand just whin ye wuz blowin' to th' swabs in th' ould hooker alongside about th' snap ye had; 'r because ye had a shower bath whin ye always preferred a Frinch roll rim enamelled tub an' hadn't anny other kind in y'r house an' wuz agin baths annyhow; they just cudden't bear t' hurt y'r feelin's an' th' skipper, wid tears in his eyes, an' his voice shakin' wid emoshun, handed ye y'r thirteen dollars and twinty three cints and bid ye good bye an' would ye kindly make room f'r the dir-rty cur behind ye th't wuz waitin' f'r th' job f'r a change.

"An' th' ships is gettin' so's a man can't have no comfort anny more. Be th' powers, Mulvaney says they've got to fittin' iron beds, wid shprings, an' runnin' wather, an' makin' a man kape things clane, an' stickin' baths an' liberar-ries an' things foreninst him th't he has no use f'r, an kickin' if a man tur-rns in wid his boots on because it don't kape th' beddin' clane, an' now they-ve all got th' for-rced dhraft an' th' fire hole's so cowld a man has to be all th' toime a climbin' out on deck to get war-rm.

"An' he says they're buildin' thim so th't anny dago th't niver seen a shovel kin be kapin' shteam wid nawthin' to bur-rn but dirt, an' at that there's more min in th' fire hole th'n ever. Sure it's no wonder, Hooligan, th't no dacent union man wants th' job."

"There's too manny dagos and squareheads, annyhow," said Mr. Hooligan.

"Right ye are", said Mr. Casey, "but there don't seem to be anny wan else. Th' rest uv th' byes all wants to be union off'cers 'r be on th' binifit list. But I don't see why ye kick on th' dago. He hasn't kicked on wur-rkin' wid th' union man, tho' I'm sure he don't owe ye anny good will. But there's too manny of him. We've too manny bloody furriners here I says. This immygrashun of undesirable citizens sh'd be put a stop to, I says. Maybe Danny Keefe 'll be afther doin' somethin' to help us Amer-ricans t' presarve our rights. Down wid th' tyrants I says. Where, I says, does Sailor Bill an' Jasphur Shaydle an' that bunch come by th'r license to tell us free Amer-rican citizens they'll be afther shtoppin' our pay if we don't like to wur-rk wid the dir-rty furriner. Keefe knows what th' are. Haven't they bin payin' him f'r knowin'? When Tony an' Ole shtruck th' ore dock Danny wuz there wid th' glad hand. 'Wilcome to Amer-rica,' he says. 'In this great and glorious counthry iv-ry man has th' right to do as he likes,' he says. 'No man shall dictate to ye,' he says. 'Ye can have all ye want to ate and dhrink if annybody 'll thrust ye,' he says. 'Ye can vote f'r Bryan iv'ry four years,' he says. 'Be jinin' th' union ye can quit wur-rk anny toime th' job don't suit ye,' he says. 'F'r th' palthry sum of umsteen thousand dollars I'll be y'r prisidint an' do me best t' kape th' gang fr'm scrappin', kape th' dues paid up an' th' treasurer fr'm goin' t' Mexico,' he says. An' they did ut, which shows th't Danny wuz th' man f'r th' job of takin' in th' furriner.

"But th' owners has no bizness mixin' in. Sure, all they-ve a right t' do is set up th' ships an' th' jobs an' pay th' bills, an' not come meddlin' wid our affairs. Hooligan, y'r bein' throdden under fut. Wan by wan y'r liberties is bein' invaded. Ye'll soon be rejuced to th' same level as poor Jawn D. What's th' use of payin' dues t' kape a prisidint an' sicrity an' a threasurer an' a bus'ness a-agent on th' job if any bloody furriner can get as much pay as a good union man, even whin he don't make so much noise? An' what's goin' t' become of all these off'cers if th' owners 'r goin' t' boss th' job an' give ye all th't union cudden't get an' some to that. I'm thinkin' they 'll have t' go to wur-rk, an' it's a low down thrick to for-rce a man to 'arn his livin' whin he's not bin used to ut.

"Well, well, times is changin'. I mind whin I wuz in th' fire hole an' ut tuk a good man t' shtay there. We hadn't no for-rced dhraft t' help us in thim days, an' iv'ry skipper an' ingineer wuz f'r makin' all th' time th' ould hooker cud shtand f'r, an' that put ut up t' th' bye in th' fire hole. Manny's th' day I fired me ton an' a half an hour, six hour watches, watch in an' watch out, an' claned me four fires an' got th' ashes overboord besides. An' where's the bye doin' ut t' day, an' what's more, where's th' bye th't can do it?

"An' thin comes th' union, but th' good wans wasn't th' leaders in th' great uplift, as th' profissors an' magyzine writers an' y'r other well manin' but misguided frinds calls ut. Most of th' good wans dhropped out, as I did mesilf.

"An' thin th' owners begins to see th't racin' iv'ry thrip isn't anny fun f'r annybody but th' skipper, an' they begins cuttin' down speeds an' thryin' to make a little money f'r somebody besides th' coal man, an' so th' byes in th' firehole av coorse had to have more money an' more help an' shorter watches. An' why not, I says. By not shovelin' so much coal wasn't ye makin' money f'r th' owner, an' shudden't ye have a whack at ut? To be sure ye shud. An' that bein' the case, ut loggye'lly follows, as Mulvaney says, th't th' more ye didn't do th' more men ut tuk t' do ut, an' th' more ye shud have f'r doin' ut, 'r not doin' ut, I'm not rightly sure which."

"D'ye mane t' say", said Mr. Hooli-

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gan indignantly, "that there's not as good min in th' fire hole t' day as iv'ver there was? Why shudden't there be?"

"Jist that, said Mr. Casey, "an' yez can figger th' why out f'r y'rsilf."

DETAILS OF A CARGO STEAMER.

At the Institute of Marine Engineers on March 15, W. Vesey Lang read a paper on the "Details of a Cargo Steamer."

Taking as the type of ship to be dealt with the ordinary cargo steamer of 6,000 to 7,000 tons, Mr. Lang said the details required careful consideration in regard to first cost, working economy, maintenance, and provision against repairs. The chief objection to "spec" ships was that everything was to the barest classification rule size and no allowance was made for wear and tear. It was to be noticed that the majority of these were permanent disqualifications as it was beyond practical considerations to renew or alter marts, winches, donkey boilers, etc., while such details as steam pipes, exhaust, suction and delivery piping and electric wiring, put to do bare requirements, could never be called upon to do extra work when required. For scantlings, steel was the usual material for the modern hull, but weather decks should be of iron to better withstand corrosion. It was also desirable that 'tween decks and tank tops should be of iron.

He advocated extra steel scantlings of iron thickness at tank margin strakes, floors, angles, and intercostals under engine and boilers, division plate floors, bottom or coaming plates of each watertight bulkhead and of bracket plates connecting bulkheads and stiffeners to tank tops. Dealing with the subject of windage, he thought a bow form of superstructure would be a great advantage to speed, and from the navigating bridge would give a clear sea view well abaft the beam on either side when standing at the center position or forward on angle.

The advantages claimed for joggling shell plating were considerably outweighed by the probable loss of displacement and grain space, and also the extra cost of renewing and repairing.

The barges Scotia and Plymouth and steamer Arizona will be offered for sale to the highest bidder on April 20, 1909, at 11 a. m., at the dock of the Guy & Ralph Gray Co., Cleveland, O. Charles H. Carleton, receiver of the Guy & Ralph Gray Co.

The Matson Navigation Co's Steamer Lurline.

WE PRESENT herewith sections and a brief description of this ship which has been built by the Newport News Ship Building & Dry Dock Co. for the Pacific trade between San Francisco and the Hawaiian Islands. The ship is built under Lloyds three-deck rule to their highest classification and her principal dimensions are: Length over all, 436 ft.; beam molded, 53 ft.; depth, molded, to upper deck, 33 ft. 6 in.; load draught, 26 ft.; corresponding displacement, 10,000 tons.

Longitudinally the ship is divided into four holds, and main and spar decks are laid all fore and aft. An orlop deck is worked from the stem to the after end of No. 1 hold. All decks are of steel and the spar deck is laid with yellow pine in forecastle, midship house and poop. Gangways are fitted between decks at all holds. The frame spacing throughout is 26 in. Scantlings are shown on midship section, Fig. 1.

She is fitted with three steel masts, the fore and main equipped with derrick booms for handling cargo. The mizzen spar is also fitted with one 5-ton boom for handling engine room weights. The crew's quarters, carpenter shop and the boatswain locker are forward under the forecastle deck. The dining saloon, pantry, ladies' and men's bathroom and fourteen staterooms are located in the midship house on the spar deck, while the smoking room, social hall and six staterooms are located above these on the bridge deck. The dining saloon and all staterooms are finished in white and gold and the social hall and smoking room are finished in mahogany upholstered in dark brown. The pilot house, chart room and captain's and officers' quarters are on the upper bridge deck. The engineers' quarters with those of the oilers, watertenders, firemen, cooks and waiters are aft under the poop deck, together with the galley and officers' and crew's mess room.

Propelling Machinery.

The engines are of the usual triple-expansion type with cylinders 31, 50 and 84 in. diameter with a stroke of 54 in., arranged with the high pressure cylinder forward. The cylinders are unjacketed and the high and intermediate are fitted with single piston valves, with double piston valves on the low pressure, all of which are fitted with balance pistons. The valve gear is of the usual link type. The crank shaft and pins are 16½ in. diameter with forged steel crank webs. The general arrangement of the engines and auxiliary machinery is shown in Fig. 2, which is a section through the engine room looking aft.

The main boilers are four in number of the standard single-ended Scotch type 16 ft. 4 in. diameter, 11 ft. 6 in. long. The working pressure is 180 lbs. Each boiler is fitted with four Morison furnaces, 39 in. diameter with separate combustion chambers. The grate area in each boiler is 78 sq. ft., and the total heating surface in one boiler 2,726 sq. ft. Tubes are 3 in. diameter and there are 254 plain and 106 stay tubes in each boiler. Fig. 3 shows cross section through boiler room looking aft. There is one donkey boiler also of the single-ended Scotch type 11 ft. 6 in. diameter and 10 ft. 6 in. long for a working pressure of 180 lbs. This boiler is fitted with two 44 in. Morison furnaces and 176 plain and 66 stay tubes 3 in. diameter. The propeller is of the four blade sectional type with a cast iron hub and manganese bronze blades. The diameter is 18 ft., pitch 20 ft., projected area 98 sq. ft., developed area 115 sq. ft. A fuel oil burning system is installed.

It should be added that the propelling machinery is fitted right after the manner of the bulk freight steamers which are so successful on the Great Lakes.

The ship made an exceptionally successful run from the yard of the builders to San Francisco, the engines being stopped but once for about an hour to set up high pressure piston rod packing before reaching Puntas Arenas. From there until the anchor was let go in San Francisco bay the engines were not stopped once. The average day's run was about 280 knots with about 5,800 tons of cargo and 2,300 tons of fuel besides bunkers.

In addition to the usual auxiliary machinery, a large Chase towing machine of the improved type is fitted aft.

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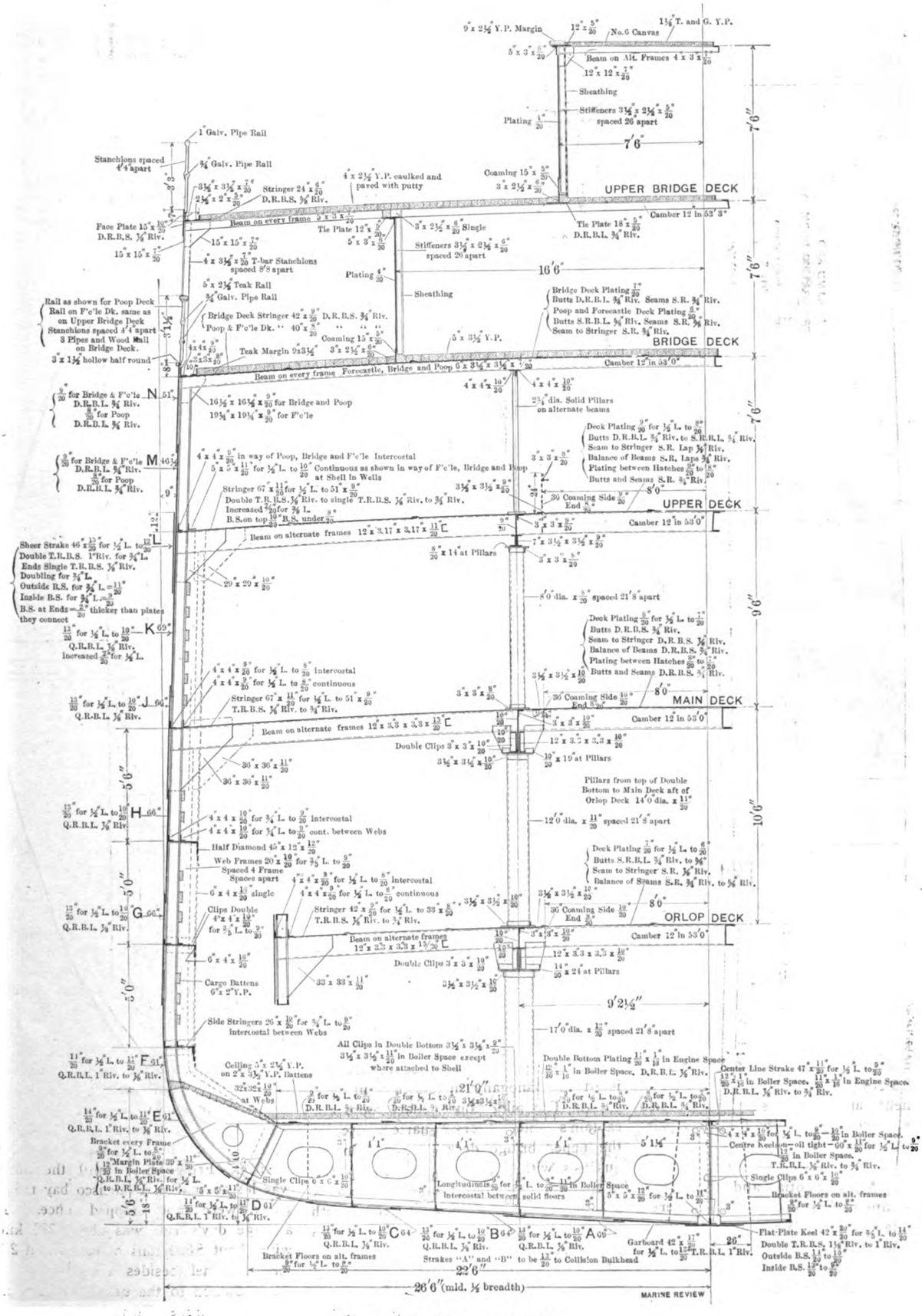
UPPER BRIDGE DECK
BRIDGE DECK
UPPER DECK
MAIN DECK
ORLOP DECK
7'6"
9'6"
10'6"
5'6"
5'0"
5'0"
16'6"
9'2½"
17'0" dia. x 15/20 spaced 21'8" apart
12'0" dia. x 11/20 spaced 21'8" apart
8'0" dia. x 5/20 spaced 21'8" apart
Camber 12 in 53'0"
Camber 12 in 53' 3"
Sheathing
Plating 4/20
Stiffeners 3½" x 2½" x 5/20 spaced 26" apart
Coaming 15" x 5/20
Bridge Deck Plating 7/20
Butts D.R.B.L. ¾" Riv. Seams S.R. ¾" Riv.
Poop and Forecastle Deck Plating 8/20
Butts S.R.B.L. ¾" Riv. Seams S.R. ¾" Riv.
Seam to Stringer S.R. ¾" Riv.
Deck Plating 9/20 for ½" L. to 9/20
Butts D.R.B.L. ¾" Riv. to S.R.B.L. ¾" Riv.
Seam to Stringer S.R. Lap ⅝" Riv.
Balance of Beams S.R. Laps ¾" Riv.
Plating between Hatches 9/20 to 10/20
Butts and Seams S.R. ¾" Riv.
Deck Plating 8/20 for ½" L. to 7/20
Butts D.R.B.S. ¾" Riv.
Seam to Stringer D.R.B.S. ⅝" Riv.
Balance of Beams D.R.B.S. ¾" Riv.
Plating between Hatches 9/20 to 10/20
Butts and Seams D.R.B.S. ¾" Riv.
Deck Plating 7/20 for ½" L. to 6/20
Butts S.R.B.L. ¾" Riv. to ⅝"
Seam to Stringer S.R. ⅝" Riv.
Balance of Seams S.R. ¾" Riv. to ⅝" Riv.
Beam on every frame 6" x 3" x 7/20
Beam on every frame Forecastle, Bridge and Poop 6 x 3½" x 3½" x 7/20
Beam on alternate frames 12" x 3.17" x 3.17" x 11/20
Beam on alternate frames 12" x 3.3 x 3.3 x 13/20
Beam on alternate frames 12" x 3.3 x 3.3 x 15/20
Beam on Alt. Frames 4" x 3" x 7/20
Tie Plate 18" x 8/20 D.R.B.L. ¾" Riv.
Tie Plate 12" x 8/20
Face Plate 15" x 10/20 D.R.B.S. ⅞" Riv.
15" x 15" x 7/20
4" x 3½" x 7/20 T-bar Stanchions spaced 8'8" apart
1" Galv. Pipe Rail
Stanchions spaced 4'4" apart
¾" Galv. Pipe Rail
5" x 2½" Teak Rail
Rail as shown for Poop Deck
Rail on F'c'le Dk. same as on Upper Bridge Deck
Stanchions spaced 4'4" apart
3 Pipes and Wood Rail on Bridge Deck.
3" x 1½" hollow half round
Stringer 24" x 6/20 D.R.B.S. ⅝" Riv.
Bridge Deck Stringer 42" x 9/20 D.R.B.S. ¾" Riv.
Poop & F'c'le Dk. " 40" x 8/20 " " "
Teak Margin 9" x 3½"
4" x 4" x 8/20 x 8/20
3" x 2½" x 6/20
4" x 2½" Y.P. caulked and paved with putty
9" x 2½" Y.P. Margin
12" x 5/20
No. 6 Canvas
1¼" T. and G. Y.P.
5" x 3" x 6/20
12" x 12" x 7/20
3" x 2½" x 6/20 Single
Stiffeners 3½" x 2½" x 6/20 spaced 26" apart
5" x 3½" Y.P.
4" x 4" x 10/20
23¾" dia. Solid Pillars on alternate beams
16½" x 16½" x 9/20 for Bridge and Poop
19¼" x 19¼" x 9/20 for F'c'le
9/20 for Bridge & F'c'le D.R.B.L. ¾" Riv.
8/20 for Poop D.R.B.L. ¾" Riv.
4" x 4" x 6/20 in way of Poop, Bridge and F'c'le Intercostal
5" x 5" x 11/20 for ½" L. to 10/20 Continuous as shown in way of F'c'le, Bridge and Poop at Shell in Wells
Stringer 67" x 11/20 for ½" L. to 51" x 9/20
Double T.R.B.S. ⅝" Riv. to single T.R.B.S. ¾" Riv. to ⅞" Riv.
Increased 2/20 for ⅜ L.
B.S. on top 10/20 B.S. under 8/20
3½" x 3½" x 9/20
30" Coaming Side 9/20 End 8/20
3" x 3" x 8/20
7" x 3½" x 3½" x 9/20
3" x 3" x 8/20
20" x 20" x 10/20
8/20 x 14" at Pillars
Sheer Strake 46" x 12/20 for ½" L. to 12/20
Double T.R.B.S. 1" Riv. for ¾" L.
Ends Single T.R.B.S. ⅝" Riv.
Doubling for ¾" L.
Outside B.S. for ¾" L. = 11/20
Inside B.S. for ¾" L. = 9/20
B.S. at Ends = 2/20 thicker than plates they connect
12/20 for ½" L. to 10/20 — K 69"
Q.R.B.L. ⅜" Riv.
Increased 2/20 for ¾" L.
4" x 4" x 9/20 for ½" L. to 8/20 Intercostal
4" x 4" x 8/20 for ½" L. to 8/20 continuous
Stringer 67" x 11/20 for ½" L. to 51" x 9/20
T.R.B.S. ⅝" Riv. to ¾" Riv.
13/20 for ½" L. to 10/20 — J 66"
Q.R.B.L. ⅜" Riv.
Double Clips 3" x 3" x 10/20
3½" x 3½" x 10/20
12" x 3.3 x 3.3 x 10/20
10/20 x 19" at Pillars
30" x 30" x 11/20
Pillars from top of Double Bottom to Main Deck aft of Orlop Deck 14'0" dia. x 11/20
13/20 for ½" L. to 10/20 — H 66"
Q.R.B.L. ⅜" Riv.
4" x 4" x 10/20 for ¾" L. to 9/20 Intercostal
4" x 4" x 10/20 for ¾" L. to 9/20 cont. between Webs
Half Diamond 45" x 12" x 12/20
Web Frames 20" x 10/20 for ⅗" L. to 9/20
Spaced 4 Frame Spaces apart
6" x 4" x 13/20 single
4" x 4" x 8/20 for ½" L. to 8/20 Intercostal
4" x 4" x 8/20 for ½" L. to 8/20 continuous
Stringer 42" x 9/20 for ½" L. to 33" x 8/20
T.R.B.S. ⅝" Riv. to ¾" Riv.
3½" x 3½" x 10/20
30" Coaming Side 10/20 End 8/20
12/20 for ½" L. to 10/20 — G 66"
Q.R.B.L. ⅜" Riv.
Clips Double 4" x 4" x 10/20 for ⅗" L. to 9/20
6" x 4" x 10/20
Cargo Battens 6" x 2" Y.P.
Double Clips 3" x 3" x 10/20
3½" x 3½" x 10/20
12" x 3.3 x 3.3 x 10/20
14/20 x 24" at Pillars
33" x 33" x 11/20
Side Stringers 26" x 10/20 for ¾" L. to 9/20
Intercostal between Webs
All Clips in Double Bottom 3½" x 3½" x 9/20
3½" x 3½" x 11/20 in Boiler Space except where attached to Shell
Double Bottom Plating 11/20 x ⅞" in Engine Space
12/20 x 1" in Boiler Space. D.R.B.L. ⅝" Riv.
Center Line Strake 47" x 11/20 for ½" L. to 9/20
12/20 x 1" in Boiler Space. 11/20 x ⅞" in Engine Space.
D.R.B.L. ⅝" Riv. to ¾" Riv.
Ceiling 3" x 2½" Y.P. on 2" x 3½" Y.P. Battens
32" x 32" x 10/20 at Webs
9/20 for ⅜" L. to 8/20 D.R.B.L. ⅝" Riv.
8/20 for ⅜" L. to 7/20 D.R.B.L. ⅝" Riv.
8/20 for ⅜" L. to 7/20 3½" x 3½" x 12/20
9/20 for ½" L. to 8/20 D.R.B.L. ⅝" Riv.
9/20 for ½" L. to 8/20 D.R.B.L. ⅝" Riv.
11/20 for ½" L. to 11/20 — F 51"
Q.R.B.L. 1" Riv. to ⅞" Riv.
14/20 for ½" L. to 11/20 — E 61"
Q.R.B.L. 1" Riv. to ⅞" Riv.
Bracket every Frame 9/20 for ½" L. to 8/20
Margin Plate 39" x 11/20 in Boiler Space
Q.R.B.L. ⅞" Riv. for ½" L. to D.R.B.L. ⅝" Riv.
5" x 5" x 11/20
14/20 for ½" L. to 11/20 — D 61"
Q.R.B.L. 1" Riv. to ⅞" Riv.
Single Clips 6" x 6" x 10/20
Longitudinals 9" for ½" L. to 8" — 11/20 in Boiler Space
Intercostal between solid floors
5" x 5" x 12/20 for ½" L. to 11/20
4" x 4" x 8/20 for ½" L. to 8/20 in Boiler Space.
Centre Keelson — oil tight — 60" x 12/20 for ½" L. to 9/20
13/20 in Boiler Space.
T.R.B.L. ⅞" Riv. to ¾" Riv.
Single Clips 6" x 6" x 10/20
Bracket Floors on alt. frames 8" for ½" L. to 8/20
12/20 for ½" L. to 10/20 — C 64"
Q.R.B.L. ⅞" Riv.
13/20 for ½" L. to 10/20 — B 64"
Q.R.B.L. ⅞" Riv.
14/20 for ½" L. to 10/20 — A 66"
Q.R.B.L. ⅞" Riv.
Bracket Floors on alt. frames 8" for ½" L. to 8/20
Strakes "A" and "B" to be 13/20 to Collision Bulkhead
Garboard 42" x 17/20 for ½" L. to 12/20 T.R.B.L. 1" Riv.
26"
Flat Plate Keel 42" x 9/20 for ⅗" L. to 14/20
Double T.R.B.S. 1⅛" Riv. to 1" Riv.
Outside B.S. 14/20 to 13/20
Inside B.S. 12/20 to 9/20
22'6"
26'6" (mld. ½ breadth)
MARINE REVIEW

FIG. 1—MIPSHIP SECTION.

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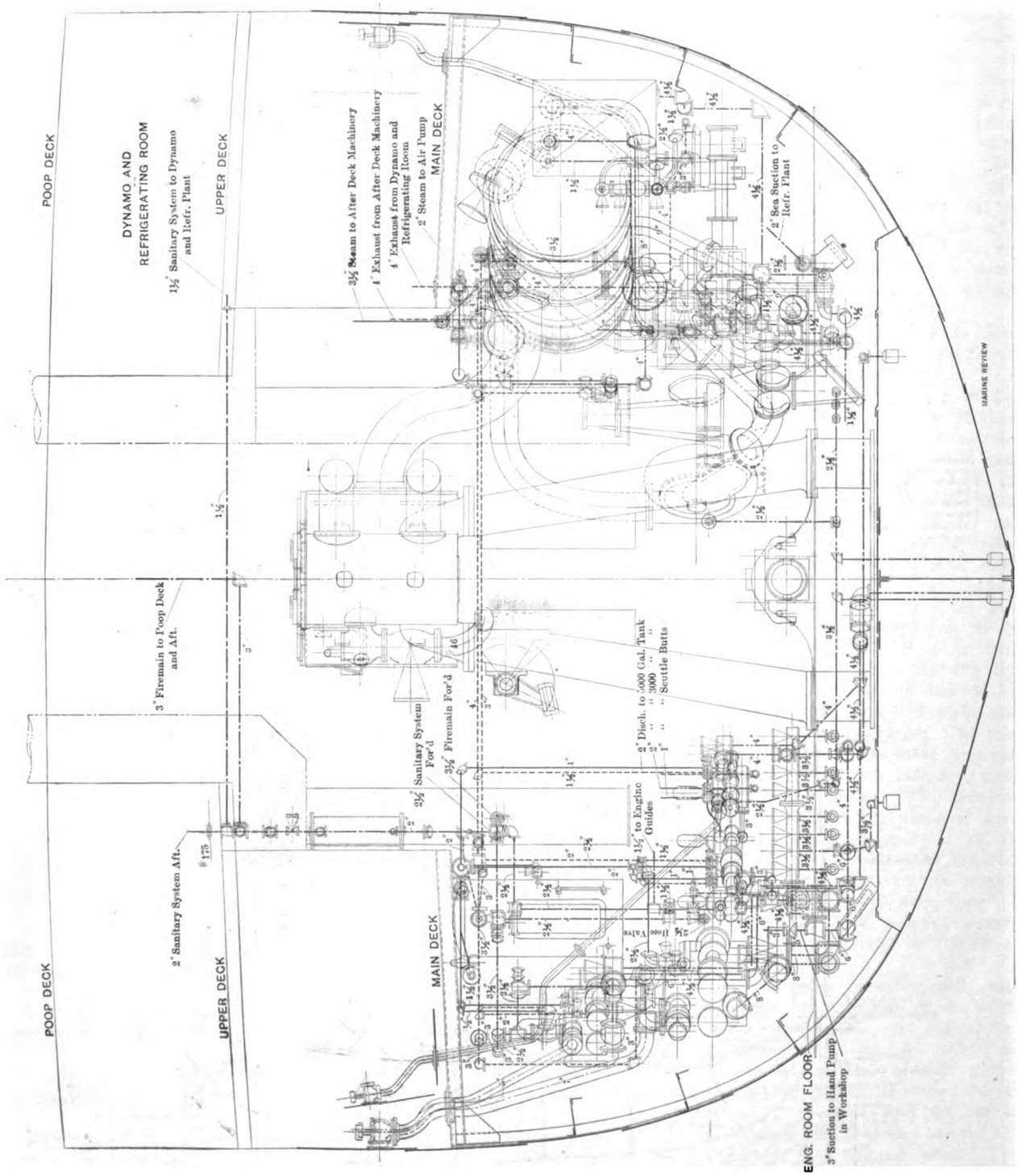
POOP DECK
DYNAMO AND REFRIGERATING ROOM
1½" Sanitary System to Dynamo and Refr. Plant
UPPER DECK
3½" Steam to After Deck Machinery
4" Exhaust from After Deck Machinery
4" Exhaust from Dynamo and Refrigerating Room
2" Steam to Air Pump
MAIN DECK
2" Sea Suction to Refr. Plant
3" Firemain to Poop Deck and Aft.
2½" Sanitary System For'd
3½" Firemain For'd
9" Disch. to 5000 Gal. Tank
" " 3000 " "
" " 1 " "
Scuttle Butts
1½" to Engine Guides
2" Sanitary System Aft.
POOP DECK
UPPER DECK
MAIN DECK
Hose Valve
ENG. ROOM FLOOR
3" Suction to Hand Pump in Workshop
MARINE REVIEW

FIG. 2—SECTION THROUGH ENGINE ROOM LOOKING AFT.

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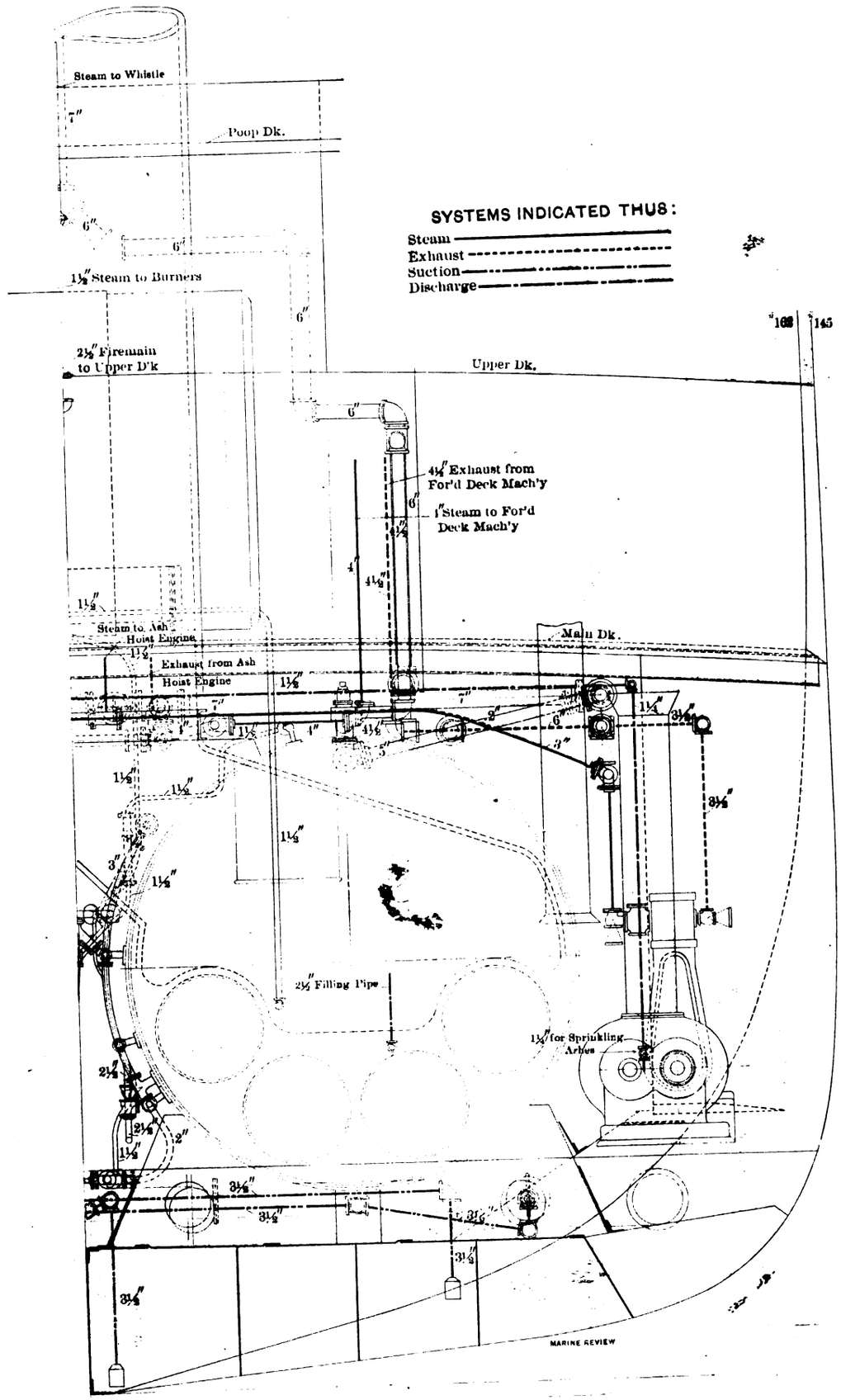

FIG. 3—HALF SECTION THROUGH BOILER ROOM LOOKING AFT.

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"HYDROPLANES" OR "SKIMMERS."*

BY SIR JOHN I. THORNYCROFT.

VESSELS which greatly reduce their displacement when traveling at high speeds are generally called "hydroplanes", but this name is not altogether satisfactory, as the surfaces on which they glide are not always planes. To call such vessels "gliders" or "skimmers" has been suggested as more appropriate, but the former title suggests smooth motion, and this is not always a characteristic of their behavior. In this paper, therefore, the latter word will be used to describe boats which at high speeds are heavier than the water they displace. "Skimmers" are very ancient, and are still used by some of the inhabitants of islands in the Pacific, in what must be their simplest form. A single slab of wood, rounded at the edges, is employed, and supports a man where huge waves form a sufficient slope to enable him, assisted by gravity, to attain the necessary start. After the start the man will even assume a standing attitude on the board which skims along before the advancing wave.

The problem of making a boat glide steadily on the surface of the water is not an easy one. Steadiness can probably be gained by using a number of planes, but this is likely to increase the frictional resistance. When a number of planes are used to support a given load, each must be of less length

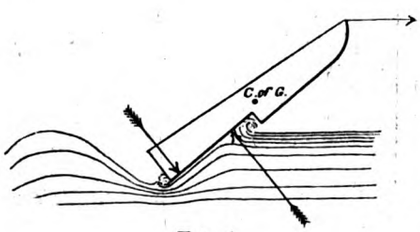

FIG 1.

than when only one is used. The friction per unit of surface being greater for short surfaces, it is improbable that a smaller total surface will be sufficient, and the necessary power required for a given speed must be greater. Mr. Froude's opinion was that the best results could be obtained from a single plane, but this must maintain a particular angle to the water surface. About the year 1872 he made a model, in which three surfaces were attached to a frame, and towed in such a position that the wake of either of the three did not interfere with the water on which any one of them had afterwards to run. Mr. Froude proved by theory that the angle the plane should have to the line of motion should be such that the resistance due to surface friction should be equal to the resistance due to gravity, or the horizontal component necessary to balance the weight of the vessel on the incline of the supporting surface. This inclination he found to be about 1 in 17, so that the total resistance amounts to about 1/8.5 of the weight or displacement of the vessel. This friction, however, depends on the value to be attached to the surface friction, and this also varies with the quality of the surface and the length of the surface rubbing. This inclination is therefore not a definite angle.

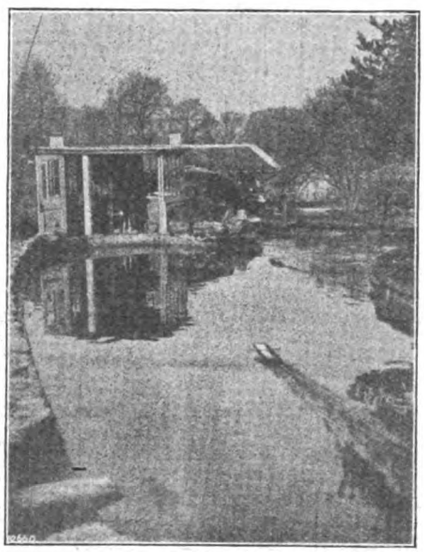

FIG. 4.

Mr. Froude found, when experimenting with the Ramus model that the front plane lifted entirely above the water surface as the speed was increased, and the center of gravity apparently overhung all natural support, as shown in Fig. 1. It is evident that this effect can only be produced by the pressure on part of the surface being less than that of the atmosphere. The author had made some experiments to illustrate this with a model, the bottom of which was, for the most part, a simple plane, but at the after end the surface could be turned to a slight angle, and the result was that in some cases the model even jumped clear of the water surface. When the bottom surface was left flat throughout its length, the model glided smoothly over the water; but when the tail part was bent down, the model promptly dived. A photograph taken of this operation, a little too late to show the model, clearly showed the hole in the water where it disappeared. These experiments seemed to show that the endwise vertical section of the bottom of a skimmer should be a straight line; although a hollow curve would seem to promise a more even distribution of pressure on the bottom.

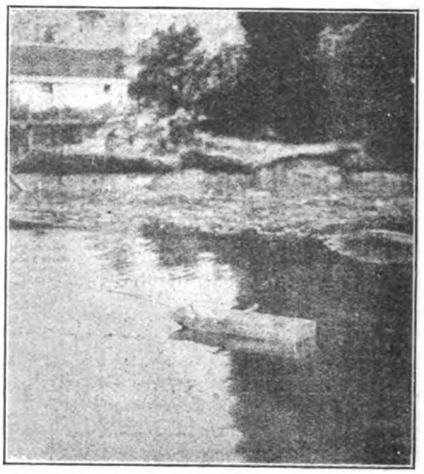

FIG. 2.

In a boat intended for skimming or sliding on the surface of the water with the least possible disturbance, there are a number of elements to consider. Unfortunately, these do not all lead to the same proportions of design. In the first place, the lifting force depends on the amount of surface and on the speed; while the friction for a certain amount of surface will decrease with greater length. The speed at which skimming will commence, however, increases with the length. This limit

FIG. 3.

*A paper read at a meeting of the Motor Yacht Club, London, on Thursday, March 4, 1909.

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should naturally be kept as low as possible. Below a certain velocity, the performance of a skimmer model is very bad, owing to the formation of large waves, which allow the stern of the vessel to fall and greatly increase the angle of the planes, thus rendering it more difficult for the vessel to mount to the surface and skim. This difficulty may be lessened by (1) extending the amount of supporting surface, or (2) reducing the weight of the vessel, the surface remaining the same. The great strength necessary to withstand the shocks to which this kind of boat is subjected, renders reduction of weight difficult. A boat very wide and short in shape leads to excessive air resistance, and this resistance becomes quite an important factor at speeds of about thirty miles an hour. For this reason too great a width must be avoided.

The wave formation, when a skimmer is moving below the skimming phase, still higher speeds the motion of the water becomes unsteady. Fig. 4 incidentally shows the house from which the author's experiments were conducted. It contains a winding-drum for the tow-line fitted with recording apparatus.

Skimmers are near relations to flying-machines, and although smooth water would appear to form a definite plane on which to travel, a boat of this kind, when moving at high speed, is not content to be limited to motion in two dimensions, but tends to oscillate vertically and jump from the water surface, and under some conditions to dive below. The skipping action has been already referred to above, the author's model having been frequently made to leave the water temporarily in this way, at relatively high speed.

The position of the center of gravity of the relative merits of the vessels is very important to get the best result. In the models he had tested, improvement appeared to take place as this was moved aft up to the stage when skipping or flapping commences. This dancing motion, if allowed to develop, may become dangerous, but the best results seem to coincide with its commencement.

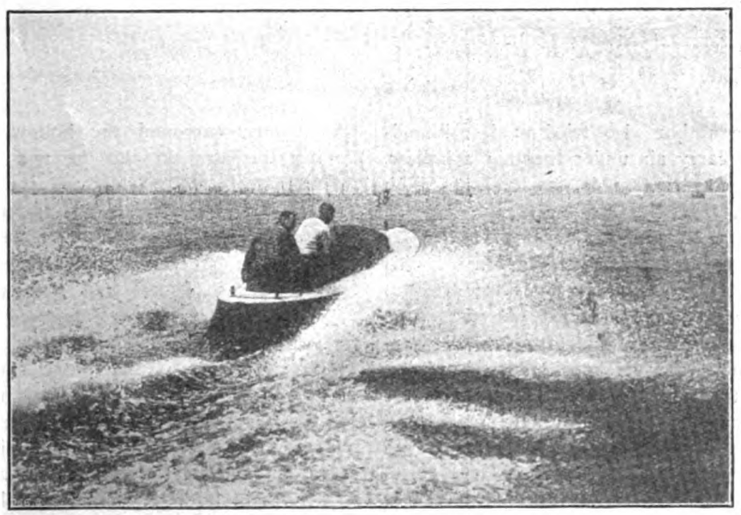

FIG. 5.

resembles that of an ordinary vessel, but the waves are larger in proportion to the size of the vessel, and diverge at a wide angle. Some photograhps taken during recent experiments by the author, on a Ramus model, illustrate this. Fig. 2 shows the model used, and the lines by which it was drawn along. It will be seen that the boat is fitted with a cross-piece, or bar, to which the lines are attached. The lines join some little distance ahead and astern of the boat, to form a single tow-line. Fig. 3 is an illustration of the Ramus model at low speed, showing the primary waves and echoes. The contrast is great when the same model is made to travel fast. This is shown in Fig. 4, and here it will be seen that the volume of the waves is much less and the angle of divergence is small. At

It has been suggested that the motor boat Gyrinus lifted to some extent, and so reduced its displacement, like a skimmer, but the photographs of the boat at full speed clearly show that such is not the case; for while the bow is nearly at the same level at rest or speed, when moving fast, the stern is much lower. The fore part of this boat appears to plough a channel, into which the stern falls, and with increase of speed the resistance rises very rapidly, although the form of stern would appear well adapted to avoid this result. The lines of the Gyrinus produced by vertical longitudinal sections rise very gently, and terminate in a sharp angle; therefore there is no surface which can suck the water up, and, by so doing, reduce the pressure below that of the atmosphere.

The growth of resistance in a skimmer differs from that in an ordinary boat in a very marked manner; it rises very rapidly at first with increase of speed, but when the condition of skimming is established, it may even fall temporarily, and afterwards only

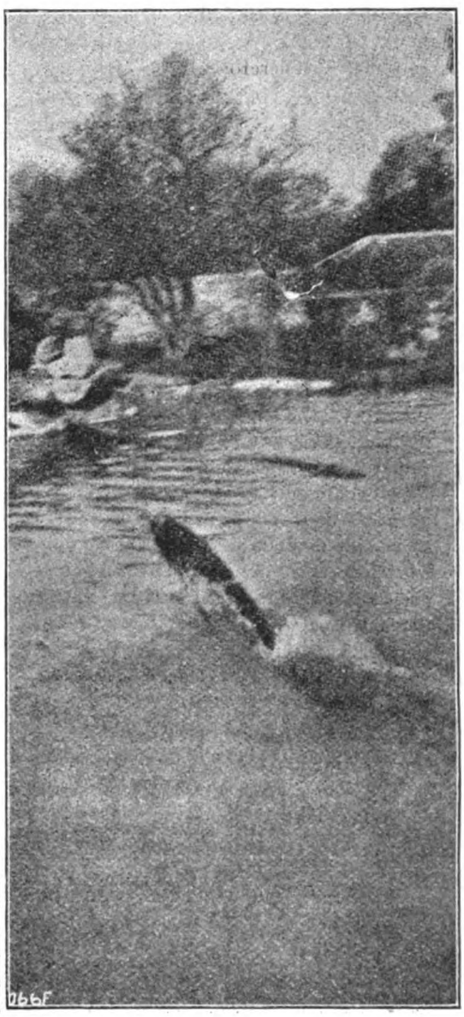

FIG. 6.

rise very slowly, so that the power required only increases a little faster than the velocity. This is well illustrated by the diagram, Fig. 7, below in which the resistance of the Gyrinus and a skimmer of the same weight is plotted, in which case the curves cross at about 17 knots. The boat form is much the better for lower speeds, while above the point where the resistances are equal the advantage is greatly in favor of the skimming model.

Experiments were made with the

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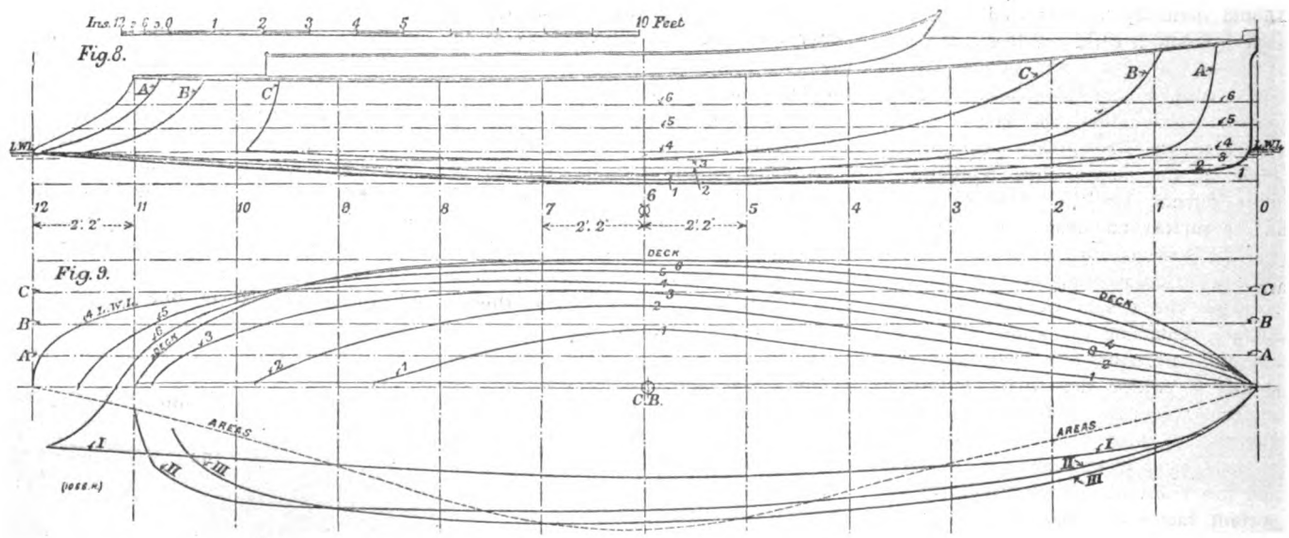

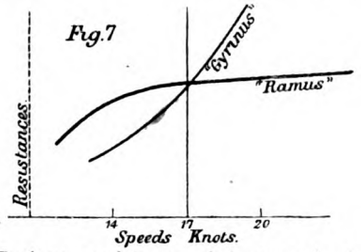

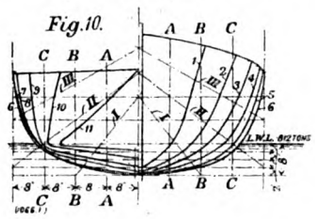

Gyrinus model, towed backwards, to illustrate the clinging of water to the rounded form of stern, which the bow then represented; and although this gave no trouble at ordinary speed, the effect at extreme speeds is surprising. The real stern lifts and the bow is depressed until the vessel makes a large angle with the line of motion (Fig. 6), as was found to be the case when Mr. Froude towed the Ramus model.

It is often supposed that air passes under skimmers, but this is only likely to take place when the water surface is broken. It is well known that a jet of water impinging on a surface, even at an acute angle, does not all pass under in the direction of the jet. A small part at a point near to the surface has its motion reversed. This reversal renders the passage of any air between the jet and the surface impossible. If, however, the surface of the moving water is broken or churned into foam, then that mixture of air and water will pass along the surface. What will be the effect of this seems uncertain, but the late Lord Kelvin was thoroughly of opinion that the friction of this mixture would be greater than that of solid water. The form of boat used by M. Fauber is adapted to eject any air from under it, and, perhaps, from this some advantage was obtained which tended to balance the loss which might be expected to arise from the use of so many short skimming surfaces.

The author also tried models intended to carry air under them in a hollow. This construction is favorable to high speed, for the angle of the surface rubbing on the water can be considerably reduced by the adoption of this plan, so reducing the resistance due to gravity on the incline. At the same time the friction due to air on the supporting water is much less than that due to water on a solid; and if the air could be carried with the model, the power required to force it under would be small and would only amount to that necessary to make up waste. It may be safely taken that when air goes under a vessel without forcing, it will fail to give any support. It is evident that the air under a vessel to serve this purpose must have a pressure above that of the atmosphere.

In a skimmer in which the water rubs directly on the bottom surface, the center of pressure is always forward of the center of area; but in a vessel in which the support is due to air in a hollow, it must coincide with the center of gravity of the area of the hollow. It is much more advantageous to have such a definite center of support than the ever-shifting position of the center of the lifting force due to contact with the water surface. The practical difficulties, however, to be overcome in producing a type embodying this principle are many. Care must be taken, for instance, to avoid disturbing the water surface by the surfaces which must surround the hollow containing the air. If this be not done, waves will form and increase the rubbing surface, besides taking up energy in their formation. With a model the author designed to overcome these difficulties the resistance had not proved very small, but it was observed that the wake of the model indicated very little disturbance of the water surface. This model was very wide and nearly circular in plan, and it skimmed at quite a low velocity. It may be interesting to state that this form of model was made in 1873. A similar model was towed from a launch at about 8 knots; this speed was more than sufficient to make it rise to the surface. When air was forced under it, the resistance was greatly reduced, but it was never very low. At the best it fell to a value of about one-quarter the weight of the model. At a lower speed—about 5 knots—a greater resistance was recorded.

It has often been proposed to force air under a vessel of ordinary form, and Ericson is said to have tried this, but found it was not a success. In a skimmer, however, if the air can be carried with the model for the most part, there must be an advantage in this system, and perhaps it might also be used with advantage in very shallow vessels, not intended to skim, but having a very large surface of bottom, and not requiring the air to be pumped against much head of water.

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"In the Merchant Service."

"Anything wrong down below?" The second until this moment had been engrossed in the evening meal so had failed to notice that the third and his assistant were absent from the mess table. Also, if there was anything wrong with the machinery in his charge he wanted to know about it.

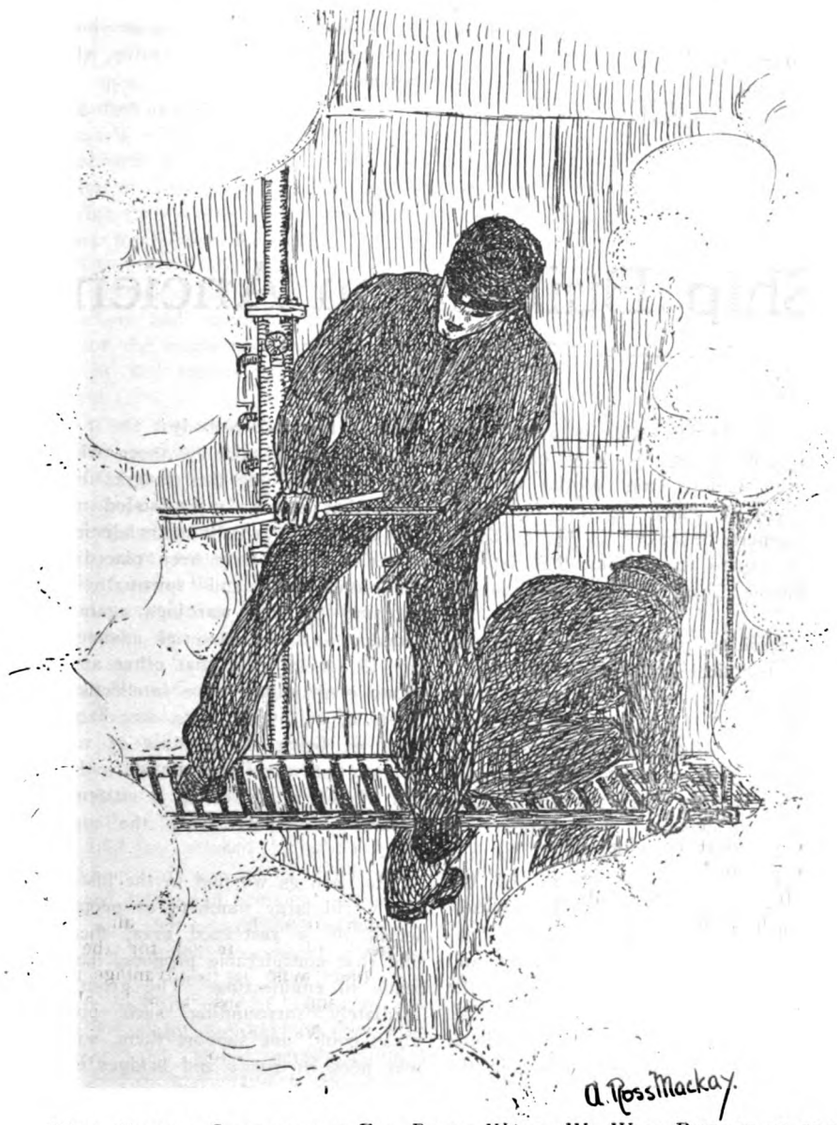
"Not that I've heard of, sir," answered the steward. There was a momentary halt in the rattle of cutlery and dishes and in the general conversation, but with the reassuring words of the steward the mess-room assumed its usual meal-time appearance. So long as the steward had received no orders to arrange for the late arrival of the missing engineers nothing serious was the cause of their non-appearance.

Conversation, hitherto covering all manner of subjects, now asumed a professional turn, due to the absence of the third. They were still discussing the probabilities of certain parts of the auxiliary machinery having given out during the third's watch when that individual hurriedly entered the mess-room followed by his assistant and threw himself scowling into his accustomed seat.

"Hullo, Smith," said the second, in a surprised tone, "something give out down below?"

"Naw," grunted the third, "nothing gave out."

"Nothing warmed up?" asked the second, as was his privilege.



"THEY STARTED CLEANING THE FIRE BELOW WHERE WE WERE PUTTING IN THE GLASS."

"Naw," answered the still scowling engineer. 'Soup, steward."

"Short of water, maybe?" The others grinned. It's great to have a humorous second.

"SOUP!" The steward carefully balanced the plate of soup across the room and placed it on the table, and the third pitched in in scornful silence. The others silently but smilingly filed out. Every ship carries a chronic grouch in one department or the other.

The second was enjoying his after-dinner smoke when the third casually dropped in to talk things over. He was still scowling.

"Say," snarled the third, "if this blessed old hooker isn't hoodooed, I'm a Dutchman!"

"What's the trouble this time?" asked the second.

"Well," said the third, as he helped himself to the tobacco of his superior officer, "I suppose that you are aware that it is dirty weather on deck and we are shipping seas down the boiler room?"

"I should guess as much," commented the second.

"All watch it has been merry hell down there. Steam went away back, as the men couldn't get enough coal in front of their fires to keep things going. The floor plates were awash most of the time, too, and the ashes and coal got mixed. The men—"

"But that is nothing unusual around this time of the year," the second interrupted.

"Aw, isn't it?" The men wouldn't work, either, on account of the seas coming down the air shafts. The men in the wings would skip out and leave their fires like a lot of frightened women every time a bucketful of water would come from on top."

"Where were you while all this excitement was transpiring?" asked his listener.

"Where was I? Right in the thick of it, of course!"

"Got soaking wet, too, I'll bet," said the second sympathetically.

"Naw, I didn't get wet. You see I didn't want to catch a chill like I did last winter, so most of the time I stayed in the shelter of the boilers," the third explained.

"Good judgment," commented the smiling second.

"Sure. Then when we were trying to get the ashes up the hoist gave out. I sent for the electrician to come and have a look at it, but he sent back word that he was busy in the pilot-house or some such other remote spot."

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"Well, you know, he has a lot of gear to look after."

"I know that. So I sent that bright assistant you placed on my watch to see what the trouble was, as I was in a hurry to get the ashes up. I'm blessed if he didn't come down the ladder in about ten minutes to say that he couldn't find out what the trouble was. So then I—"

"I suppose he got drenched."

"Surest thing you know. He was wet through to the skin and shivering with the cold."

"So then you went up?"

"Naw," said the third, hastily, "so then I had the ashes wheeled into the other boiler room and sent them up that way."

"Good judgment, again," said the second, sarcastically.

"Yes. I knew the hoist could wait till the weather got better, so long as the other was in working order. At the change of the watch the fourth comes down looking for trouble. He first said that we had skipped some of our ashes, just because we hadn't managed to get them all wheeled through before the watch was up. He had the nerve to want me to go up and find out what was the matter with the hoist, too! Then he said that there was no coal on the plates for his clean fires, but I said 'what's the use of putting coal out just to have it washed into the wings?' "

"Lumps won't wash into the wings," argued the second.

"I know that; but my men were wheeling ashes and didn't have time to go into the bunkers and look out round coal. He said that we were short of water in the boilers, too!"

"And were you?" asked the second.

"Well, I might have been," answered the third, reluctantly. "It's mighty difficult to judge what water you're carrying when the ship is wallowing about the way this old hooker is."

"Fine old moss-grown excuse." The second spoke witheringly, and the third looked injured.

"I'm only telling you all this as I know the fourth won't be able to tell you quick enough when you go on watch, especially if things aren't all right."

"What made you get in so late to dinner?" asked the second.

"Well, you see, a gage glass burst just before we got up the ladder, and—"

"Perhaps the fourth fired a piece of coal at it," suggested the smiling second.

"That's what I thought," answered his subordinate, seriously. "It was on the for'ard end of the center boiler, too. To make matters worse my noble assistant had his hand hurt by a clinker hitting it when he was climbing the ladder to the hoist, so I had to lend a hand on the glass. In taking the broken glass out Harris dropped one of the nuts down on the floor plates, where it mingled with the coal. By the time I had run along the grating and climbed down the ladder a sea had washed the coal across the boiler room, taking the nut with it."

"Why didn't you jump down on it?"

"And break my blessed neck? Well, the fourth wouldn't let his men stop firing long enough to let us search through the coal, so, by the time I had found the storekeeper and got another nut some considerable time was lost. We were just getting along all right when you won't guess what the fourth did."

"Tell me."

"Well, he gave his men the wink and they started hauling out the fire right below where we were working on the glass."

"Perhaps it was his first fire."

"That was the excuse he gave. He yelled out in front of his men, too, that we were taking long enough to fit a new end on the boiler! It's only his size saves him. How could we work in all that smoke and steam?"

"Vapor," corrected the second.

"Well, vapor," growled the third "since you're so darned particular."

"It's a hard life," commented the second, as he refilled his pipe.

"It is, on this rattle-trap," was the third's parting growl, "I wouldn't sail on this old hooker another trip for a hundred a month."

The second, when alone, smiled quizzically. Second engineers know—as does also the engineer awaiting promotion—that the man who is always threatening to resign has the postage stamp beat a mile when it comes to sticking.

THE "STAND-BY" MAN.

Ship Building in Ancient History.

Geo. W. Dickie, who is known the world over from his long connection with the Union Iron Works of San Francisco, of which he was for many years general manager, in his presidential address to the Technical Society of the Pacific Coast in January, said in part:

"In thinking over what I might say to the technical society at this annual meeting, I have been embarrassed by the fact that this duty has developed upon me so often that I have already exhausted the general technical subjects that usually form the groundwork for such addresses. This embarrassment was further increased by the presence of the gentlewomen of the society, to whom I must address myself as well as to the members. I concluded, partly for the instruction and benefit of our better halves, to air the superiority of the engineer and his work over that of all other professional men of this and all other times in the history of the world; in fact, I might take the Scotchman's toast for my subject, which in English is, 'Here is to us! Who is like us? Nobody.'

"It is often said by those who desire to point out the dangers of our time, that our so much-lauded modern civilization is grossly materialistic, that material things have been placed above the intellectual and spiritual. After listening to such warnings against the tendency of our material advancement, one is apt to infer that other and previous civilizations were intellectual and spiritual, or, at any rate, free from the taint of being the product of the engineer; yet when one considers the origin of the word "civis," a citizen, it is naturally associated with the constructive.

"As soon as we find in the history of the world large numbers of people collected on a restricted area, there we find that considerable progress has been made in engineering. The ground immediately surrounding such populous areas could not support them, so there was need of roads and bridges or else ships to bring them their food. The earlier civilizations in Europe began in countries with extensive seaboards, to

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which access could be had by shipping. Greece was largely an archipelago, and the mainland was so indented by bays that ships could penetrate into a large portion of it. Rome was not far from the sea, while Italy had the longest shore line in Europe. The ship was then the most elaborate piece of mechanical engineering to which mankind had attained, and where the ship could penetrate, civilization developed. Our own rough, unkempt ancestors gained what little knowledge they had of the arts from the ships of the Phoenicians who visited their shores in the summer. In fact, the earlier civilizations were developed by engineers just as directly as our own civilization is due to the engineer.

"Fenelon tells us that, when Telemachus landed at Tyre, that city of the sea crowded with the traders of every nation, her own people the most eminent merchants in the world and the vessels in the harbor so numerous as almost to hide the water in which they floated, he gazed with insatiable curiosity upon the great city in which all was motion and energy, men busy loading vessels, dispatching or selling their merchandise, putting their warehouses in order or keeping an account of the sums due them from foreign merchants. Turning to Narbal, the captain of the Phoenician vessel that brought him to Tyre, he asked by what means the Phoenicians had monopolized the commerce of the world and enriched themselves at the expense of every other nation.

"'You see the means,' answered Narbal; 'the position of Tyre renders it more fit for commerce than any other place, and the inventions of navigation are the peculiar glory of our country, for we have reduced the theories of Egyptian and Babylonian science to practice, regulating our courses by night, when we can see no landmarks, by the stars; thus we bring together innumerable nations which the seas have separated. Such are the means by which we have subjected the seas to our dominion and included every nation in our commerce. But if jealousy and faction should break in among us; if we should be seduced by pleasure or by indolence; if the great should come to regard labor and economy with contempt, and the manual arts should no longer be deemed honorable; if public faith should not be kept with the stranger, and the laws of commerce violated; if the ship building art should be neglected and those sums withheld which are necessary to make the instruments of navigation perfect of their kind,—that power which is now the object of your admiration would soon be at an end.'

"Telemachus wanted to know still more about this interesting civilization and the arts that produced it, so he asked Narbal again by what means the Tyreans had become so powerful at sea. To this query the captain answered:

"'We have the forests of Lebanon, which furnish sufficient timber for building ships, and we are careful to reserve it all for that purpose, never suffering a single tree to be felled but for the advancement of commerce; and we have a great number of our people very skilled in ship architecture; these are the gradual product of our own country. When those who excel in such arts are constantly and liberally rewarded, they will soon be practised in the greatest possible perfection, for persons of the highest ability will always apply themselves to those arts by which great rewards are to be obtained. Our kings have bestowed rewards and honors upon whoever excels in any art or science on which navigation depends, and skillful ship builders are not only well paid, but treated with deference by all the people, as on their work depends the welfare of our nation.'

"I think the Great Teacher whom so many of us accept as the Lord and Master of the race must have known how good the king of Tyre was to the ship builders when He said that it would be better for Tyre in the day of judgment than for the men of his generation; and for the same reason might we not say that in the day of judgment it will be better for the lawmakers of ancient Tyre than for the gentlemen of this generation who sit for us in Washington and do nothing for the upbuilding of our over-sea commerce?"

Book Reviews.

The Steam Turbine. By James Ambrose Moyer New York. John Wiley & Sons. 6 x 9 inches. 370 pages. Illustrated. Cloth. Supplied by the MARINE REVIEW for $4.

This book is an addition of distinct value to the literature on the subject of steam turbines. The author has reversed the usual order of developing the subject, presenting first the elementary theory of heat and the problems of nozzle design. This is followed by a discussion of steam turbine types and blade design. In this manner the author has presented the simpler problem first and, it seems to us, in the most logical order. The first chapter, which is entitled, "The Elementary Theory of Heat", discusses and explains in a simple manner the entropy-temperature diagram. The treatment of this usually difficult subject is most lucid, and those who have had trouble with it can well afford to read this chapter of the book. The second chapter on nozzle design presents numerous formulae as to the dimensions of nozzles and explains clearly the effect of variations in the shape of a nozzle on the action of the steam passing through it. The calculations are carefully worked out in a form, which should prove of material value to the designer. Chapter IV discusses the various types of steam turbines and distinguishes clearly between the impulse and the reaction turbine, the action of the steam in the various parts being illustrated by means of velocity diagrams, the use of which is explained in connection with the laying out of a turbine. Chapter VI discusses the method of making steam turbine tests to reduce them to standard conditions, while Chapter VII is devoted to illustrations of commercial types of steam turbines. Complete installations, cross sections, details and economy curves of various types of turbines are illustrated, the principal attention being given to turbines of the Westinghouse-Parsons and Curtis types. The other types are discussed rather briefly. Methods of testing are briefly noted in Chapter XI, while steam turbine economics form the subject of Chapter XII. Chapter XIII is devoted to stresses in rings, drums and discs, while Chapter XIV treats of the subject of gas turbines. It is regrettable that an otherwise excellent book should be marred by such a careless error as the use of the plural noun "data" with the singular verb "is". This error occurs a number of times throughout the work and should be corrected in the next edition.

Drawing Book for Marine Engineers. By Alexander Norwell, B. Sc., C. E. Pages, 95; size, 8½ by 11 in. James Brown & Son, Glasgow. Price 2s 6d net.

This book is a collection of draw-

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ings of parts of marine engines and auxiliary machinery, which have been set at various times as tests at the British Board of Trade examinations for engineers' certificates of competency. In addition to having been compiled for engineers desirous of taking the examinations, and studying for same while in service, the scope of the book has been extended so that it may form a text book of mechanical drawings for apprentices attending marine engineering classes. The drawings, 35 in number, have been specially prepared for this work and range from the most simple to the most intricate parts of a vessel's machinery. The book also contains some practical information on mechanical drawing.

Machine Details for Engineering Students. By Alexander Norwell, B. Sc., C. E. Pages, 52; size, 7¼ by 10 in. John Mitchell Pollock, Greenock. Price 1s 6d net.

The explanatory text in this work may seem somewhat elementary to the machinist or engineer schooled in machine drawing and construction, but to the student or engineer who has had limited opportunities for technical education it will be found invaluable. The first half of the book is devoted to the text, and, in addition to containing much useful information on machine design describes in detail the drawings in the second half. These latter include complete working drawings for a set of launch engines and should be of considerable assistance to those desirous of taking up the study of mechanical drawings.

Machine Drawing and Design for Beginners. By Henry J. Spooner. London and New York. Longmans, Green & Co.; 9½ x 7; 266 pages. Supplied by MARINE REVIEW for $1.25.

The author, who is director of mechanical and civil engineering in the Polytechnic School of Engineering, London, has produced a work which is almost a complete course of instruction in mechanical drawing, though in many details differing from the ordinary practice in this country, and is written in an easy, conversational style which points clearly the reason for the various rules and suggestions. The student is apparently presupposed, however, to have a much fuller knowledge of mathematics than is usually the case, in this country at least, where elementary mechanical drawing, such as covered by the first six chapters, is usually taken up in advance of the students involved in the calculations employed in design and set forth in the succeeding chapters. This is, however, merely a difference in educational systems. The work contains little or nothing which is not to the point, and the application of and the reason for the various formulae employed in the design of the parts used as examples is set forth in a clear and interesting manner. The work is profusely illustrated with examples of almost every imaginable class of work and the method of construction and reason therefor made very plain. Ordinary commercial practice in drawing office work does not permit of many of the instructions given being carried out, but these modifications will readily suggest themselves in practice.

Marine Propellers. By S. W. Barnaby; fifth edition; New York. Spon & Chamberlain; 5½ x 8½; 182 pages. Supplied by the MARINE REVIEW for $4.50.

Mr. Barnaby's work has been so long a standard that little needs to be said of this latest edition. A note giving the latest values obtained by Froude for maximum pitch-ratio efficiency is inserted and also the latest information as to designing propellers for turbine ships. A new chapter on the influence of depth of water on resistance is also added. As well known, Barnaby is neither a faddist nor a theorist. His work is chiefly based on extensive experience and careful experiment and will doubtless continue to be accepted as authority.

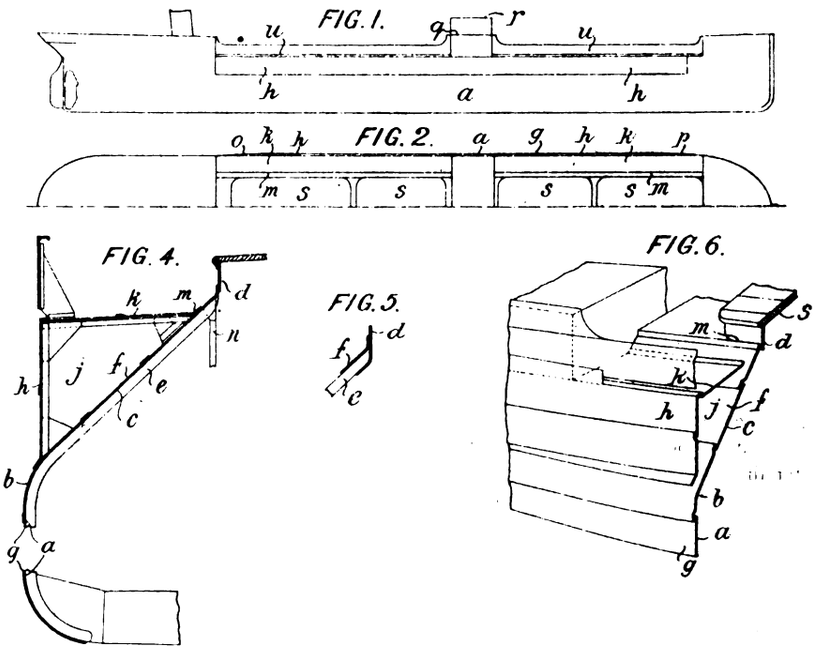
Steam Boilers. By C. H. Peabody and E. F. Miller; second edition; 6 x 9; 419 pages; New York. John Wiley & Sons. Supplied by the MARINE REVIEW for $4.

With the exception of a very brief chapter on superheaters and some new tables giving dimensions of and floor space occupied by different types of boilers, the subject matter is substantially the same as in the preceding edition of 1897.

From the Patent Office.

NEW DESIGN OF CARGO VESSEL.

An invention relating to cargo vessels of the kind having topside water ballast tanks, and particularly to that type of ship wherein the sides of the tanks are set back from alignment with the sides of the vessel, and having for its object the improvement of construction or arrangement of such vessels, has recently been patented in this country by John R. F. Dettner, of Sunderland, England. Hitherto in cargo vessels having topside water ballast tanks, whether continuous or otherwise, a number of disadvantages have been experienced by reason of the construction adopted having proven more or less faulty in that the tanks were from various causes frequently apt to leak at the joints of the tanks and sides of the vessel, particularly when subject to shocks in-



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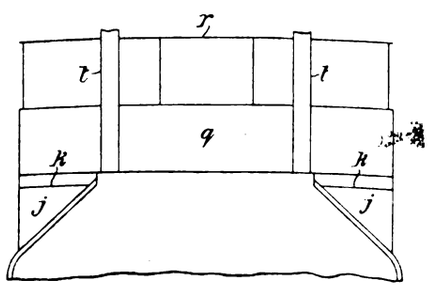
cidental to mooring vessels alongside one another or alongside quays or wharves.

In a vessel constructed in accordance with this invention the topside tanks, which are of uniform section throughout, are disposed upon the upwardly inclined or sloping sides of the vessel and extended continuously from the poop to the after end of the forecastle. The tops of the tanks are carried inwards to meet the sides of the vessel at a point below and clear of the joint between said sides and the hatch coamings, and the sides of the tanks are set back from alignment with the sides of the vessel. In order to accommodate the tanks the sides of rhe vessel are at or about the water line or a suitable distance above or below same, rounded or curved inwards and then inclined or sloped upwardly at a suitable angle and in straight lines, or in a more or less convex shape to the bottom of the side coamings of the hatchways to which the shell plating is connected.

Fig. 1, in the accompanying drawings, is an elevation of a vessel constructed

FIG. 3.



in accordance with the invention and in which the propelling machinery is arranged at the after end of the vessel. Fig. 2 is a half plan of the vessel, Fig. 3, a diagrammatic amidships section, Fig. 4, a still further enlarged part section through one of the hatchways, Fig 5, a detail, Fig. 6, a part perspective view and Fig. 7 a diagrammatic amidships section of a vessel in which the propelling machinery is arranged amidships.

Referring to Figs. 1 to 6 of the drawings, in a vessel constructed in accordance with this form of the invention the sides *a* of the vessel, continuously from the poop to the after end of the forecastle, are rounded or curved inwards at a point *b* at or about the water line, or at a suitable distance above or below same, and are inclined or carried up, as at *c*, to meet the bottom of the side coaming plates *d* of the hatchways to which the frame *e* and shell plating *f* are secured. The coaming plates are continuous from the poop to the forecastle and are decked over between the hatchways. In some cases the coaming plates may be extended downwardly and cover the ends of the frames, as shown in Fig 5.

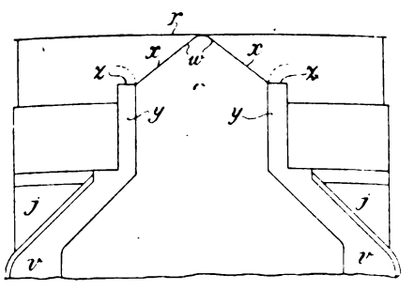
Above the sloping side *a* and set back from alignment with the faces *g*, shown in Fig. 4, of the lower portions of the sides of the vessel are disposed the sides *h* of topside ballast tanks *j* which are covered by deck portions or platforms *k* carried inwardly to meet the sloping sides at the points *m* below or clear of the coaming plates. By this construction or arrangement of the topside tanks, the tanks are not liable to damage when the vessel is being moored or is lying alongside quays or other vessels, and water-tight flats within the bottom corners of the tanks, usually difficult to make and maintain watertight, can be dispensed with.

Hold pillars may be dispensed with by the employment at suitable intervals of web frames connected to hatch webs, but, when hold pillars are required or desired they may be connected to the frames and the shell plating clear of the tanks, as shown at *n* in Fig. 4. The upper strakes of the plating of the sides of the tanks are preferably flanged in over the deck portions, and the deck portions are flanged onto the shell plating of the sloping sides, as shown in Fig. 4, so that the joints are easy of access and readily calked.

The sides of the vessel and the sides of the topside tanks are preferably parallel and without shear between the points *o* and *p* (Fig. 2) where the sides fall in at the poop and the forecastle respectively, so that the vessel is uniform in section between these points. At the poop and forecastle the sides *h* of the tank *j* merge into the ordinary shape of the vessel. Shear may be introduced to the bulwarks only or also to the poop deck, the forecastle deck and the bridge deck if desired. Amidships the vessel is a transverse saloon *q* and a bridge deck *r*.

The hatchways are made as long as possible consistent with strength, the winches for working the fore and after

FIG. 7.



hatchways being arranged on the forecastle and poop respectively, and those for working the central or amidships on the top of the saloon. Hollow posts *t* may pass up through the center of the saloon and the bridge to serve as uprights for the derricks and also as hold ventilators. The bulwark plating *u*, shown in Figs. 1 and 4, may be arranged at a suitable distance above the deck portions, thus avoiding the use of bulwark ports or scuppers.

In a vessel in which the propelling machinery is disposed amidships, as shown in Fig. 7, a casing *w* can be arranged carried up to about the height of the bridge, throughout the length of the bunker spaces, and having inclined sides *x* forming shutes leading to the bunker hatchways *y* which also extend through the length of the bunker spaces and are provided with hinged or other suitable covers *z* adapted to be turned up as indicated to direct the coal, which is delivered onto the sloping sides into the bunkers. By this construction or arrangement the bunkers are self-trimming. Suitable guides may be provided to direct the coal clear of the funnel and the boiler room ventilators if desired, or the latter may be adapted to be removed and repaired by plugs when filling the bunkers.

The top-side tanks may be arranged so that the water therein can be used in case of fire, and may be divided into compartments by water-tight divisions, some of which may be used as fresh water tanks. It is claimed by the inventor that vessels constructed on this principle, with continuous inclined or sloping sides and hatchways as long as practicable, will be "self-trimming" to a greater extent than vessels as hitherto constructed.

DESIGN OF PROPELLER.

The accompanying drawings illustrate a recent invention in propellers, the object being the provision of a propeller blade which will cause the water displaced thereby to be projected in a solid stream in parallelism with the axis of the propeller. The blade is designed to prevent the loss of power due to the water passing off of the propeller blades at the top instead of at the rear edge, its curvature being intended to insure the course of travel of the water from the leading to the trailing edges of the blade. In order to strengthen the propeller blade, and at the same time to secure a much more positive action, ribs are provided which curve upon the blade in the arc of a circle eccentric with the hub.

The blades shown are preferably

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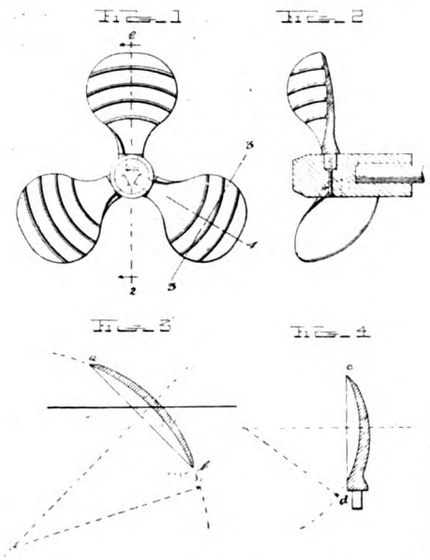


platter-shaped, that is, have a major and a minor axis through their body. The major axis *a-b* is dished upon the arc of a circle whose radius is considerably greater than the arc of the circle upon which the body of the minor axis *c-d* is dished, there being consequently a greater curvature in the blade in the direction of its minor axis than in its major axis.

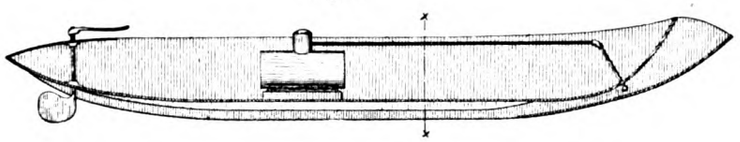
Fig. 1 is an elevation of a propeller, which can be adjusted to any desired pitch. Fig. 2 is a section on the line 2-2 of Fig. 1. Figs. 3 and 4 are diagrammatic sections on the line 3-3 of Fig. 1 and one of the blades taken on the line 4-4 of Fig. 1, respectively. The inventor is Morgan B. Miller, of San Jose, Cal.

FLUID-PROPELLED BOAT.

The boat shown in the accompanying drawings is designed for propulsion by means of a large volume of air and gas introduced beneath the forward portion of the boat in such manner that it will give the boat a forward impulse and at the same time provide a cushion of gas and air betwen the water and the under side of the boat. The lifting effect is further intensified by planes extended from the sides of the boat. Means are provided whereby the air used for propelling the boat is removed from above and in front of the boat, so as to produce in that direction a partial vacuum which will tend to draw the vessel forward and upward, so aiding the propulsion of the boat and causing it to glide over the surface of the water.

Fig. 1 is a longtitudinal section through the boat, showing forward apron or false bow forming a passage through which the gas, vapor or other fluid is discharged aft. Fig. 2 is a

Fig. 1.



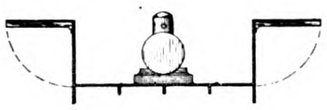


Fig. 2.

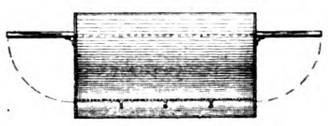


Fig. 3.

transverse section on the line *x-x* looking aft, showing keels arranged to prevent the gas and air from collecting under one side when the boat is in imperfect trim and to insure an air contact over the whole surface of the bottom of the boat. Fig. 3 is a transverse section on the line *x-x* looking forward. The inventor is Christopher John Lake, of Bridgeport, Conn.

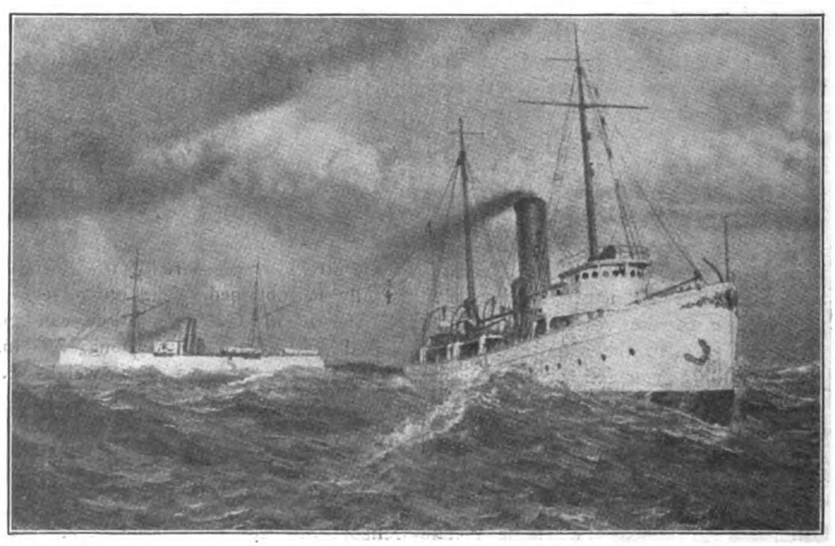
* * *

Engineer Specialties.

LIFE-SAVING STEAMER SNOHOMISH.

The steamer Snohomish of the United States Revenue Cutter Service, the first vessel ever designed and built entirely for life saving work, reached Neah Bay on the Alaskan coast safely after her journey of nearly 20,000 miles from the ship yard of the Pusey & Jones Co., Wilmington, Del. The construction of this vessel by the government is the direct outcome of the wreck of the Valencia in which 136 lives were lost. The entrance to Puget Sound through the Straits of Juan de Fuca is particularly dangerous and during the past half century it is estimated that nearly 700 lives have been lost there. Doubtless many on board the Valencia would have been saved had it been possible for some craft to reach them as the wreck stayed afloat for 36 hours after striking.

Congress ordered the establishment at Neah Bay of a first-class ocean-going life saving steamer or tug to be seaworthy under all conditions and to be fitted with every known provision for life saving. The United States Revenue Cutter Service invited the Lidgerwood Manufacturing Co. to submit a study for a small sized marine cableway, capable of carrying pas-



LIFE SAVING TUG SNOHOMISH AND REVENUE CUTTER ITASKA TESTING LIDGERWOOD-MILLER MARINE BREECHES BUOY, ARUNDEL BAY, MARYLAND, NOVEMBER, 1908.

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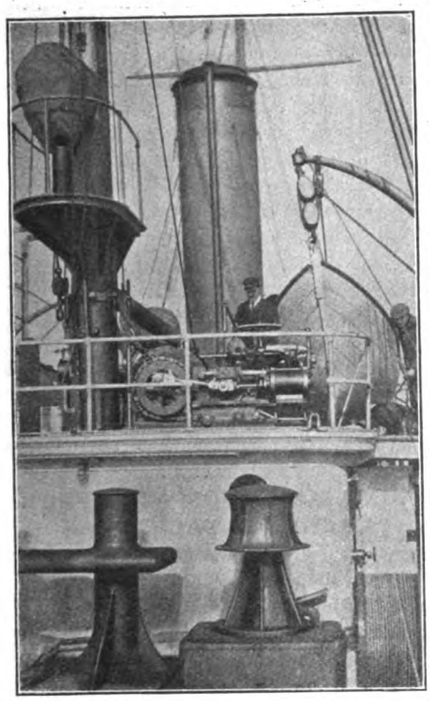
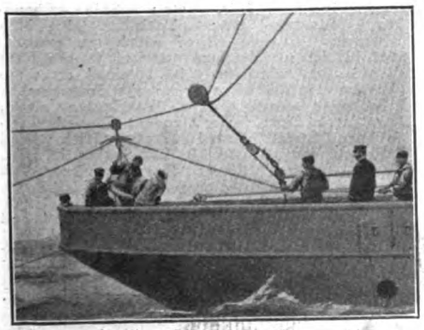


THE LIDGERWOOD-MILLER AUTOMATIC REEL ON DECK OF SNOHOMISH.

sengers between a wreck and a rescuing ship, not only in the open sea but also along the coasts. The Spencer-Miller marine breeches buoy was the result. It was given a thorough test before the Snohomish left for Puget Sound and established its practicability. The two special features of this apparatus are an automatic reel which constantly gives and takes on the cable while maintaining a tension nearly as even and constant as if the vessels were at rest, and a down-haul by means of which the passengers in the breeches buoy are safely landed on deck without regard to the boisterous character of the sea. A rust-proof cable line of light steel 1,500 ft. in length is provided. This will permit of the operation of the life saving apparatus up to more than 1,000 ft. between the vessels. In operation a



THE "DOWNHAUL" OF THE LIDGERWOOD-MILLER MARINE BREECHES BUOY.

line is shot to the wreck, as in present practice, and the men aboard make it fast at one of the mast tops. The crew of the life saving vessel then pass the life saving cable and breeches buoy to the wreck. The cable passes to the automatic reel through a block at the masthead of the life saving vessel, thus keeping it well above the seas. When the breeches buoy is hauled back and the passenger is to be taken out the down-haul is brought into action. This operates from amidship on the after deck, holding the bight of the cable always to the one spot on the deck of the life saving boat, no matter how much she may be yawing or tossing and keeping the breeches buoy in one place in relation to the vessel's deck.

GILLETT & EATON'S SPECIALTIES.

Gillett & Eaton, Lake City, Minn., recently put on the market a new and improved boiler test pump intended for use on steamboats. Every steam vessel is required to have on board some means of pumping up a boiler to the required water pressure. With this pump an attendant can readily fill the suction reservoir with water from a pail, and as the pump is constructed inside of this reservoir, there can never be any possibility of its failing to work at once and properly. Every detail of construction is designed with a view of producing a

BOILER TEST PUMP.

reliable and first class article. The plunger is made of solid Tobin bronze, the valve is a brass ball and the handle is of steel. A pressure of 600 lbs. can readily be obtained. The pump set up as shown in the illustration can be placed in a space 22 in. long, 7½ in. wide and 19 in. high. It weighs 55 lbs. Regular test gages are furnished with each pump.

Gillett & Eaton are also manufacturing a typical river boat heater. For this heater they claim that it is absolutely reliable with coils very accessible. Each head is fitted with packing glands for the feed pipe and if it is desired to examine the heater pipes all that is necessary to do is to remove the forward end, disconnect the feed pipe and withdraw intact. The forward end is sometimes modified to a T connection for the exhaust instead of a single opening as shown in the accompanying illustration. A proper drain pipe flange is attached as shown.

TYPICAL RIVER HEATER.

NEPTUNE SOUNDING MACHINE.

The Upson-Walton Co. placed the Neptune sounding machine with patent depth gage aboard three freighters on the lakes during 1908 in which the members of the firm are interested as individuals. The experiment was so satisfactory that during the present year about 50 bulk freighters will be equipped with this machine. This machine is a recent patent but it apparently has overcome successfully the weak points in other machines and is likely to prove a boon to the navigator. Its use would certainly seek to minimize accidents on the lakes, especially in thick weather.

The machine consists of a stand, together with reel containing 250 fathoms of fine piano wire, to which is attached a 25-lb. lead having a hollow space large enough to take the nickel-plated depth gage.

The working of the instrument is based on the pressure of the water, the depth gage having a very small hole, through which the water is forced against the air pressure as the lead is lowered. On being brought to the surface, the depth gage is opened and the water in it measured by a small ebony gage.

These ebony measuring gages are so designed that the fathoms measure equidistant. In every other atmospheric gage half the length is required to record the first five fathoms.

As the working of the instrument depends entirely upon the pressure of the water, soundings up to 100 fathoms can easily be taken while the vessel is going full speed.

The Neptune does away with the old method of using glass tubes, which necessarily have to be renewed for every sounding at an expense of 30 or 40 cents each. The outfit includes three of the ebony gages.

The machine is small in size, taking up little space on deck and the lead and wire is of such size as to offer little resistance to the water.

It has no spring arrangements, and

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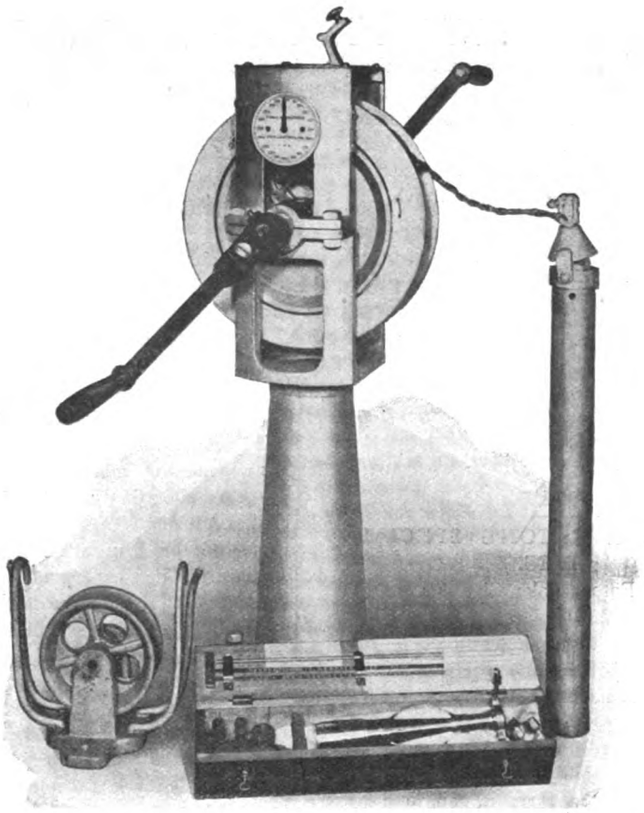

NEPTUNE SOUNDING MACHINE.

the gage is of such strength that it will stand rough handling without injury.

It works equally well in all weather, and no special instruction or extra crew is necessary to operate. If the captain wishes, he can control the machine and be sure of the exact number of fathoms by personally closing and opening the cap of the gage. The approximate depth can always be determined by the length of wire out, as shown by the dial on the machine.

ALLEN DENSE AIR ICE MACHINE.

Of the many various auxiliary apparatus which make up the complement of the modern steam vessel those whose disarrangement would worry the captain above all others are the steering engine, the arrangement for hoisting and lowering the anchor, the sanitary pump and the ice machine where the vessel is fitted with this instead of the old fashioned ice chamber. To absolutely secure the functions of the first three additional apparatus for performing their work is always provided. To make sure of any defection by the latter, in this country, the Allen dense air ice machine has mostly been used and is now after 20 years experience still the most reliable and the one which is most relied on.

The first ones in operation in the United States naval and in private service since that length of time are still doing their duty faithfully, single-handed, and the large fleet of monster men-of-war which lately circled the globe provided for its men as well as officers, fresh meat and cool water and ice every day by means of those machines, the greater number of them also having only one machine doing the whole duty single-handed. No better proof of the absolute confidence in its reliability could be had.

The new monster battle ships now commenced to be built have in addition to the meat refrigerators, other machines of the same size and kind for keeping the powder magazines at a safe cool temperature for the modern powerful powders and other explosives.

In private service the large numbers of high class steam yachts equipped with these machines, regularly fill up with meat in the northern harbor when they start for a trip into the several parts of the tropics and then have no trouble to maintain their meat supply in first class condition for months until they return to where they end the excursion. The reason of this confidence is that no gases nor high pressure chemicals are used for producing the cold but common atmospheric air properly utilized in one machine, which is so built that the usual steam engineer and oiler of the vessel needs to attend only to having it turn around like any usual steam engine and no various outside special devices are to be learned nor to be carefully adjusted.

The air is compressed in an air compressor, then cooled by water, then expanded in a steam engine cylinder.

This treatment brings the air to a temperature very far below zero.

It was done more than sixty years ago, but the design of a machine for doing this in a practically useful manner for ships service and with never failing surety is the virtue of the Allen dense air ice machine.

AUXILIARIES OF THE NON-MAGNETIC YACHT CARNEGIE.

The anchor handling machines and sail handling machines, as well as anchors of the non-magnetic yacht Carnegie, building at the yard of the Tebo Yacht Basin Co., Brooklyn, N. Y., for the Carnegie Institute, will be supplied by the American Ship Windlass Co., Providence, R. I., whose experience in this class of machinery extends from the old square rigger to the modern battleship. The company recommended a bronze windlass of the so-called fisherman type with large wooden barrels for handling the anchor hawser and wooden gypsey built for handling smaller lines. The company will also supply a special mast winch, a main sheet capstan and Providence anchors.

PROPOSALS.

Treasury Department, Office of General Superintendent, U. S. Life-Saving Service, Washington, D. C., April 7, 1909. Sealed proposals will be received at this office until 2 o'clock p. m. of Wednesday, the 5th day of May, 1909, and then publicly opened for furnishing supplies required for use of the Life-Saving Service for the fiscal year ending June 30, 1910; the supplies to be delivered at such points in New York City, Grand Haven, Mich., and San Francisco, Cal., as may be required, and in the quantities named in the specifications. The supplies needed consist of Beds, Bedding, and Furniture; Brooms and Brushes; Crockery, Hardware, Household Goods, Lamps, Lanterns, etc.; Medicines, etc.; Paints, Oils, etc.; Ship Chandlery, Stoves, etc.; Tools, and Miscellaneous Articles; all of which are enumerated in the specifications attached to the form of bid, etc., which may be obtained upon application to this office or to the Inspector of Life-Saving Stations, 379 Washington street, New York City; Superintendent Twelfth Life-Saving District, Grand Haven, Mich.; and Superintendent Thirteenth Life-Saving District, New Appraisers' Stores, San Francisco, Cal. Envelopes containing proposals should be addressed to the "General Superintendent U. S. Life-Saving Service, Washington, D. C.," and marked on the outside "Proposals for Annual Supplies." The right is reserved to reject any or all bids, and to waive defects, if deemed for the interest of the Government. (Signed) S. I. Kimball, General Superintendent.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Buffalo, N. Y. until 11 o'clock A. M., May 28, 1909, and then opened, for constructing a light-house and an iron beacon at the entrance to Cleveland Harbor, Ohio.

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